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PERSONAL COMPUTING MAY 11, 1993 VOLUME 12 NUMBER 9 $2.95

PC MAGAZINE

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PC Labs Tests Nine Top-Notch File Servers

First Looks: Novell Goes Global with Its New NetWare 4.0

Michael Miller on Software: I've Seen The Future, and It Costs $99

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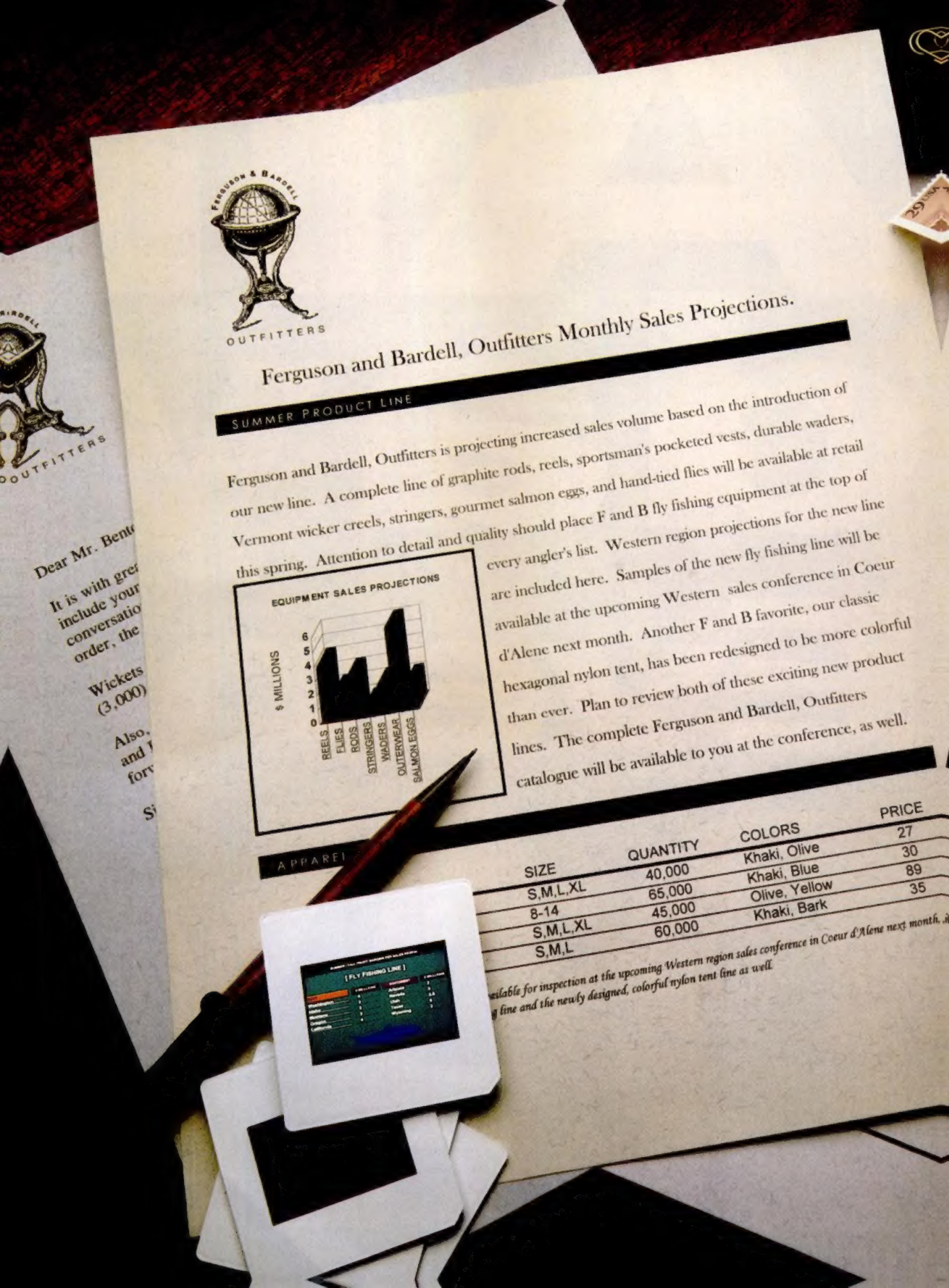

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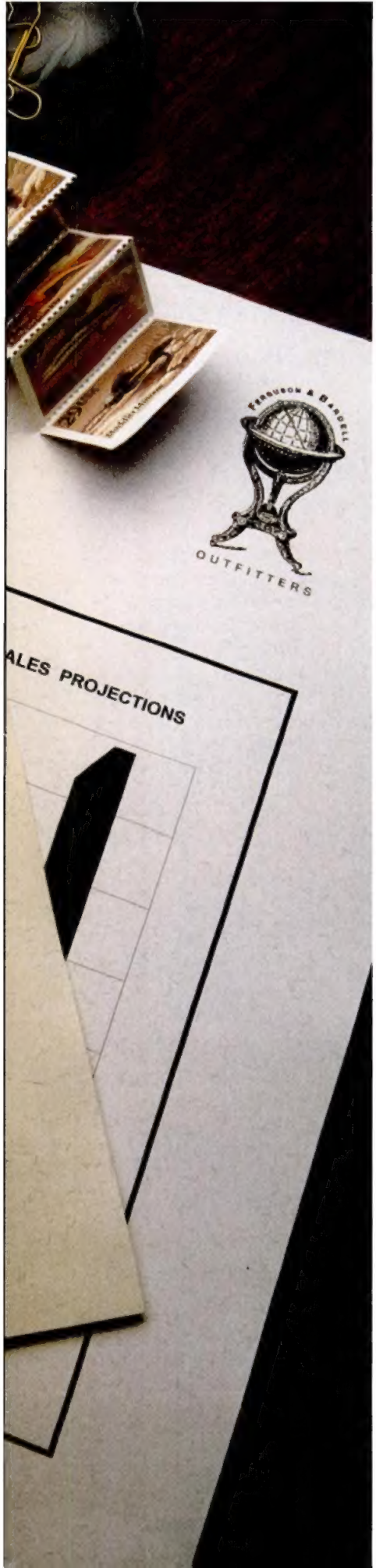

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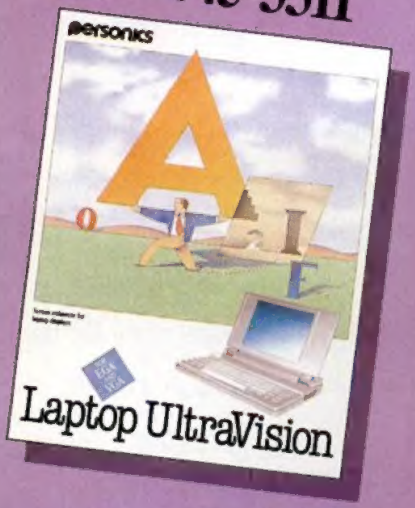

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Inside

Serving an audience of 1 million is not always easy. We know that certain reviews will appeal to the majority of our readers: widely used applications, PCs, printers. One, for example, is our cover story on relational databases.

But a magazine like ours can't afford to ignore products that appeal to an important niche or that explore new areas of technology. Even if you're not interested in buying products in a particular category today, you may suddenly discover a need tomorrow—and we're proud of our role in helping you make informed buying decisions. And with a magazine our size, even a niche is a readership that a lot of other magazines would covet.

PC Magazine plays another important role in your life. We know that we help you keep up with the galloping tide of change in the computer industry.

That's another reason that *PC Magazine* covers products that may not have mass appeal. There are often lessons in the way technology has been implemented. What applies to a very specialized product today may turn up in a widely used application tomorrow. Two of the articles in this issue illustrate our determination to keep an eye on categories that have narrow but important audiences.

In "Stat of the Art," our review of statistics packages, our software team reports that the power of statistics packages that used to run on mainframe has come down to the desktop. The emergence of Windows versions has also improved the quality of graphics you can extract from your stats packages.

Our story on full-motion video: "Desktop Video: A Window on the Future," is an example of our effort to keep you on the cutting edge of technology. Former associate editor Lori Grunin takes a close look at the issue of running video under Windows and at the products currently available. You may not be ready to attach a video clip of yourself to your next report, but after you've read our story you'll have a better understanding of how it's done.—*Joel Dreyfuss*

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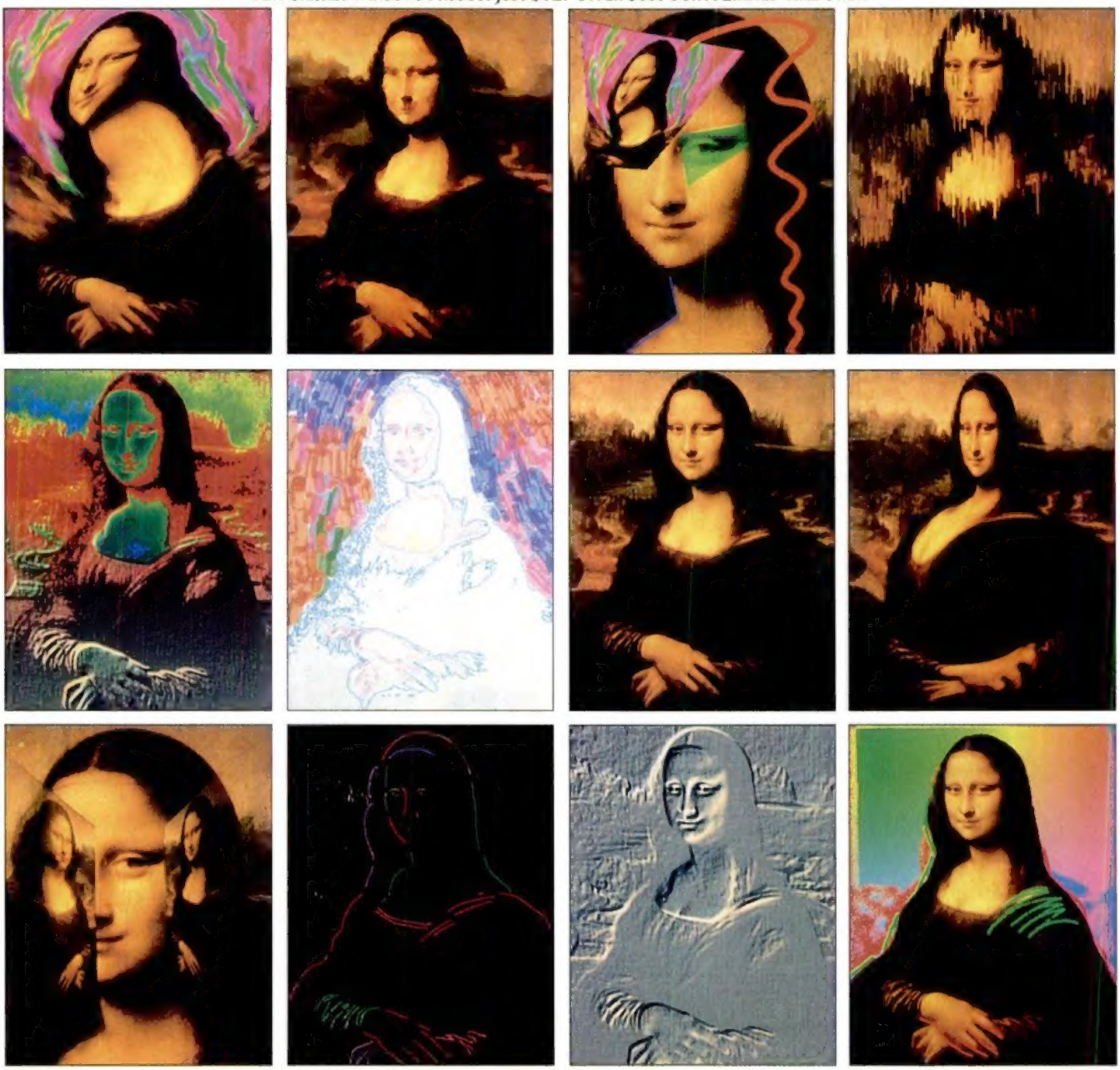

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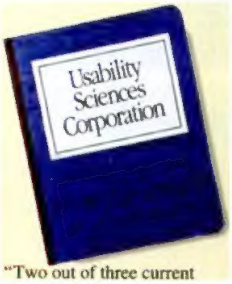

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Applications Development

New Blood, New Power

BY DAVE BROWNING The normally staid database market has been a hotbed of activity recently, with dramatic product acquisitions and a rush of new Windows versions. This review of ten relational database packages will provide some guideposts for developers who are wondering which way to turn **108**

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To Protect and Serve

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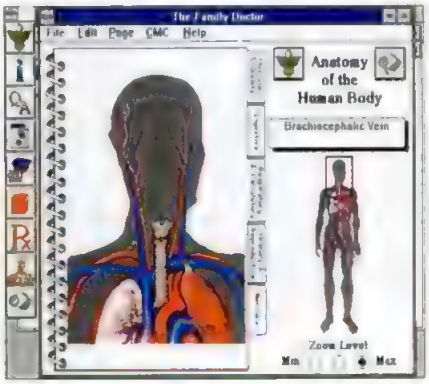

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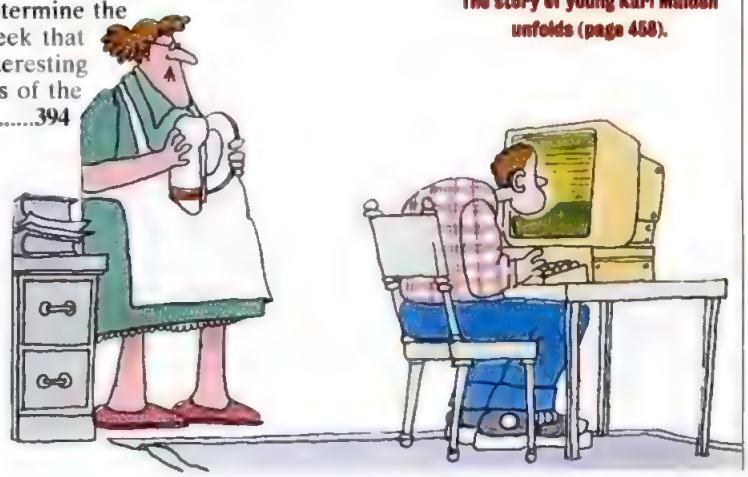

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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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*PC World, February 1993. Review of 486 Systems.

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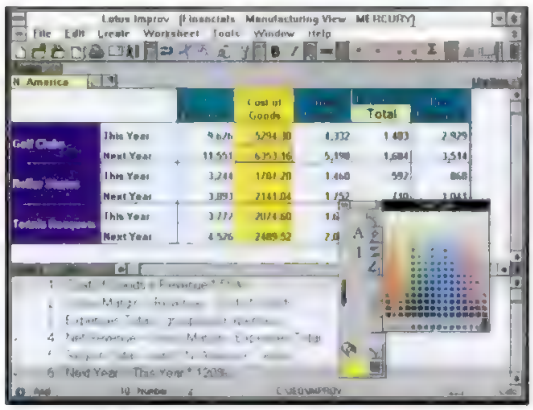

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Letters

SURE, UNIXWARE, BUT WHAT ABOUT OS/2?

In "UnixWare: The Best 32-Bit Operating System...For Now" (First Looks, March 16, 1993), you proclaim UnixWare as "the preeminent 32-bit operating system today," even though the only 32-bit operating system you compare it with is the yet-unreleased Windows NT. You totally neglect the other 32-bit operating systems that are now (and have been for a while) shipping for *x*86 platforms (not to mention other processors). These include many flavors of Unix as well as OS/2, which has shipped over two million copies and won your Technical Excellence Award.

In the past, *PC Magazine* has been rightfully criticized for its failure to give OS/2 the respect it deserves, though over recent months I've seen the situation improve. I hope your omission in the UnixWare story is an isolated incident and does not reflect a return to the previous editorial bias.

Grant A. Prellwitz
Chicago, Illinois

I don't know whether or not UnixWare is available to the general public now, but even if it is, OS/2 2.0 is the 32-bit operating system to beat.

Willis Boyce
North Brunswick, New Jersey

AMERICA ON-LINE: RATED G

I applaud your survey of on-line services ("On-Line Services: Making Meaningful Connections," February 23, 1993), but I strongly dissent from your positive characterizations of America Online, specifically its "chat" service. Your big error is in praising the system's chat service without looking at the highly oppressive, paternalistic, and downright intrusive guides—official monitors of the on-line chat areas—that run it. I found the guides to be childish, vindictive, and very selective in their judgments regarding what was vulgar. Any explicitly sexual discussions under the headings of nonmainstream variations are tolerated (even though they are visible to minors), while the most mild, nonvulgar joke can't be told in a nonsexual conference without the guides jumping down on users.

Dan Fendel
Los Angeles, California

"OS/2 2.0, not UnixWare, is the 32-bit operating system to beat."

CASE OF THE MISSING VALUEPOINTS

I was disappointed that your cover story, "Low-Cost, High-Feature PCs," (February 23, 1993) did not include an IBM ValuePoint computer. You included the IBM PS/1 2155-G44, but no ValuePoint. Will you be reviewing a ValuePoint soon?

Paul W. Wright
San Antonio, Texas

• **Testing for the February 23, 1993, review of low-cost PCs began between the announcement of IBM's new PS/1 models and that of the ValuePoint line. Unfortunately, ValuePoints shipped too late to be included. *PC Magazine* will be reviewing value-line PCs later in the year.—Ed.**

MORE HIGH-TECH WOMEN THAN YOU MAY THINK

I'm glad to hear from your article "Growing More High-Tech Women" (Trends, February 23, 1993) that there are increasing numbers of women with responsible positions in large, high-technology firms. But since I am a baby boomer, hearing about "strong feeder pools of younger women" is a little unsettling. Many older workers are investing time and energy to retrain for high-tech jobs. Will the industry bypass their skills and experience?

And as you discuss role models for women in technoloy, don't end the discussion with executives of large corporations. Many women have achieved success, and they can point to the contributions of volunteers who took the time to teach them new things and challenge them to keep learning. Major corporations aren't the only ones investing time and resources to encourage women to sharpen their technical skills.

Mary Cappuccilli
Toledo, Ohio

IT'S NOT THAT EASY BEING GREEN

I'd like to comment on Bill Machrone's "My Computer's Turning Green" (February 23, 1993). Even if there are 80 million PCs in the United States and they're "sucking down" 16 gigawatts of power, the average net load for the U.S. in 1993 is projected to be 3,078 gigawatts. That means the PC load is less than half a percent. This is hardly an environmental disaster. One has to be careful about using scare words without putting them in perspective.

Clarke Gholson
Highland, Indiana

READ 'EM THEIR RIGHTS

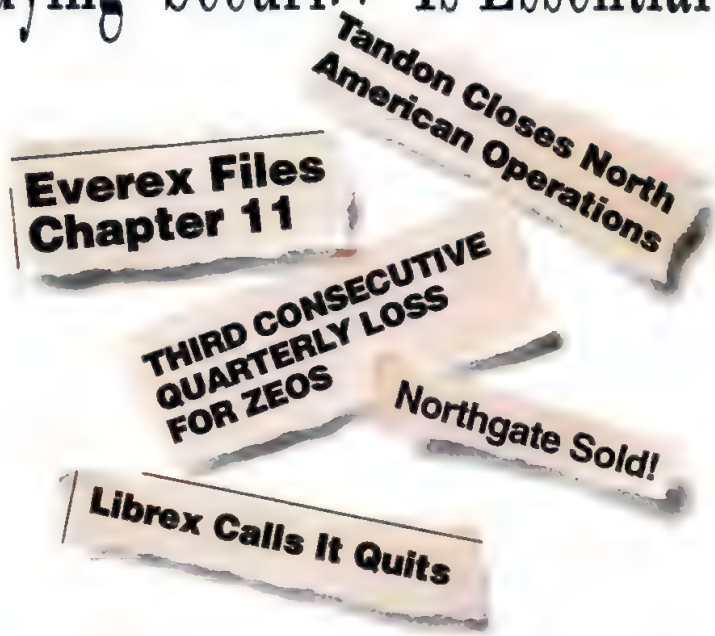
We feel that Jim Seymour's discussion of our product, the HammerHead CD-ROM, Mother Earth II, in "The Multimedia Copyright Swamp" (February 23, 1993) made our usage rights policy seem constricting and rigid. We'd like to clarify our position. Usage rights become an issue only when the images are going to be used in an advertisement or any other material from which profits are to be gained. In all other instances, people can use the images free of charge.

Andy Kasanicky
President, HammerHead Publishing
Deerfield Beach, Florida

IN DEFENSE OF SCSI

I found your article "Answers to Five Common Questions About Hard Disks"

These Days Buying 'Security' Is Essential.



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LETTERS

(Tutor, February 23, 1993) to be both accurate and informative except in its treatment of SCSI. First you state that it is possible to connect seven devices to a SCSI device, but imply that to do so would be very difficult, or at least impractical. Wrong! I routinely connect seven devices to various RISC workstations. Then you state that manufacturers have not agreed upon a standard software protocol. Wrong again! The SCSI Common Command Set was first published, I believe, in 1985. People who wish to write open systems follow the command set, while people who wish to close their systems to all but specific devices use the vendor-specific commands.

While I do agree that the implementation of SCSI devices in PCs is woefully primitive, this has absolutely nothing to do with the maturity of the SCSI standard. SCSI is now in its second major release. As a mature standard, SCSI actually predates the AT-bus interface that is often called the IDE interface.

Thomas Beach
Beaverton, Oregon

DONE WITH MIRRORS: IS THAT A PC?

I've never seen a PC quite like the one illustrated on page 120 of your story "Low-Cost, High-Feature PCs" (February 23, 1993). Holding it up to a window and viewing it through page 119, however, brought a sigh of relief.

Loren Cassell
Canyon Country, California

LEAVE MICROSOFT ALONE

The FTC investigation of Microsoft hangs like the sword of Damocles over the continued success of a major organization in the computer industry, even though Microsoft is a glowing example of what is *right* about American industry. As a result of its efforts a decade ago, Microsoft sets a worldwide standard for personal computing. Isn't it refreshing to hear an *American* success story? Are we going to smash our computer jewels because they shine too brilliantly? What we're hearing is the whining of wannabes who hope to achieve through government intervention what they have been unable to achieve in the free market.

Leon Brozyna
Jonesboro, Georgia

SMALL OS/2 DEVELOPERS ARE SUPPORTED

In response to Rob Rosenberger (Letters, February 9, 1993), I would like to say that while I wish IBM would publish and distribute a CD-ROM of current OS/2 shareware, it is doing much better than in the past and certainly isn't doing "nothing" to support developers, as Mr. Rosenberger alleges. Its Developer Assistance Program services the small, noncommercial developers as well as the commercial, corporate programmers. Many software hackers I know are happily compiling their codes on the two available (and freely distributed) ports of the GNU C++ compiler for OS/2 2.*x*, which can't be said for Windows NT.

Ping Huang
Cambridge, Massachusetts

The FTC investigation of Microsoft hangs like the sword of Damocles over the continued success of a major organization in the computer industry.

THERE'S OS/2 IN SEATTLE, TOO

I'm growing tired of reading that OS/2 doesn't have any killer applications and therefore you won't review the operating system. I am now using Lotus Freelance Graphics 2.0, Lotus 1-2-3 2.0, DeScribe 4.0, R:BASE 4.0a, and FaxWorks for OS/2. All of these programs are full 32-bit OS/2 2.0 applications that work together and are extremely fast.

Steve Schneider
Seattle, Washington

I am happy you're providing more coverage of IBM's OS/2 2.0 operating system, as in "Demystifying CONFIG.SYS in OS/2 2.0, Part 1" (Lab Notes, February 23, 1993). I've been using OS/2 since it came out, and it never ceases to amaze me. Now that there are more technically superior OS/2 apps available, I hope you will continue to expand your coverage.

Jeff Asik
Charlotte, North Carolina

CODEBREAKERS READ PC MAGAZINE

In your review of the symbolic math program, Macsyma (First Looks, February 23, 1993), you remark on its "cryptic" release number, 417.125. If you convert this number to hexadecimal, you get 1A1.2. In my opinion, "One and one is two" is not an unreasonable motto for a math package.

Paul Clapham
Vancouver, BC, Canada

GOOD TO HAVE YOU BACK

After a six-year hiatus from computers, I resumed my fascination with programming and operating them. I consider your magazine to be the best in the field. It's full of technical and programming information. You have my highest praise.

Walter M. Morrison
Irving, Texas

CORRECTIONS AND AMPLIFICATIONS

In "Computing in the Courtroom," (Trends, February 23, 1993), we did not mean to give the impression that Stenograph Legal Services' DiscoveryVideoZX multimedia system was intended to replace the traditional stenographer's machine but rather to augment it. Over time, we expect to see the two technologies merge, integrating multimedia into the court reporter's standard set of tools.

HOW TO WRITE TO PC MAGAZINE

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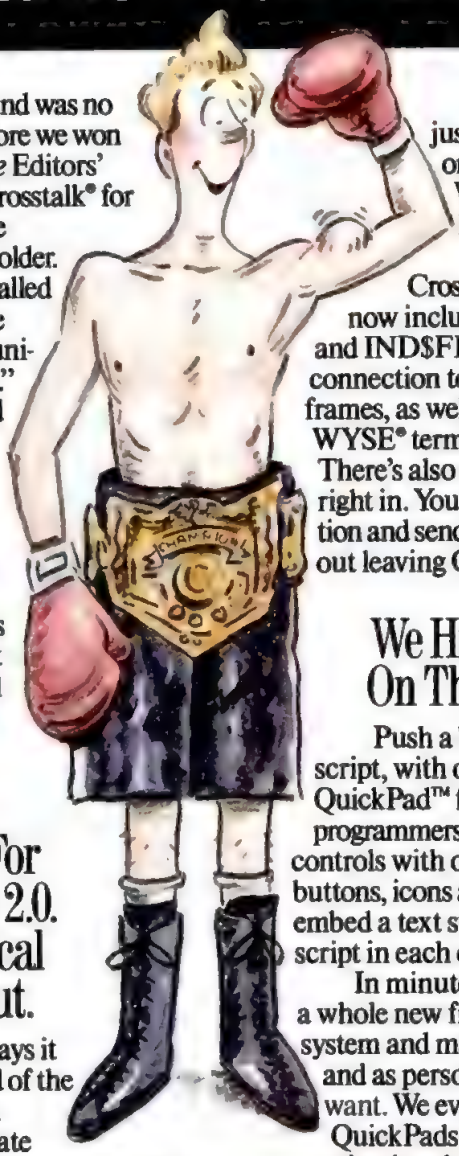
The Heavyweight Champion Of Windows Comm Software Just Became Even More Of A Knockout.



The first round was no contest. Long before we won the *PC Magazine* Editors' Choice Award, Crosstalk® for Windows was the undisputed title holder. *Software Digest* called it the "best of the graphical communications packages." *InfoWorld* named it "Product of the Year." And it won the *Windows Magazine* Readers' Choice Award.

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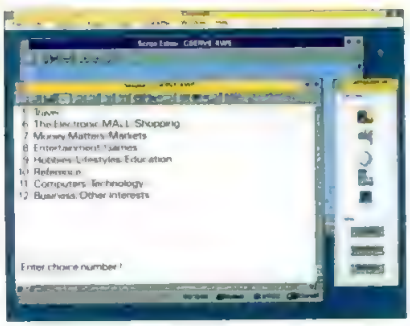

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MAG InnoVision monitors also played compelling supporting roles to seven recent award-winning systems.

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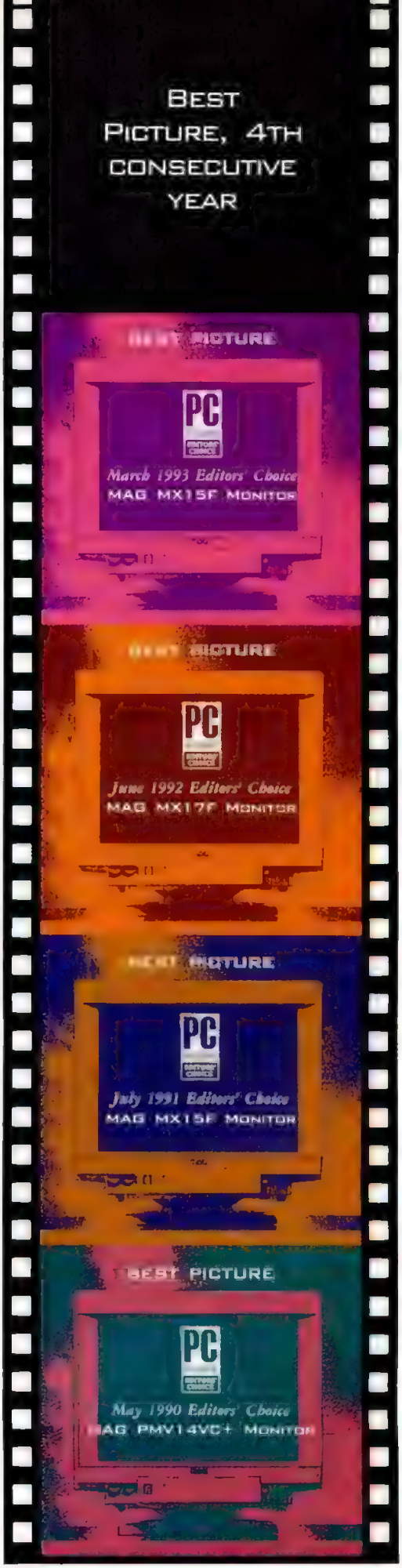
Monitors shown here are artistic presentations of the MAG MX15F model, which may or may not be the model used with the systems.



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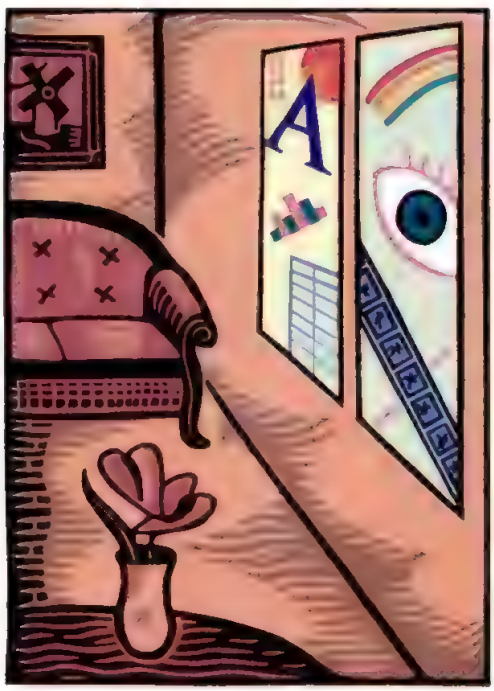
CIRCLE 344 ON READER SERVICE CARD

Electronic Wall Hangings

Fujitsu and NEC work on gas plasma.

The future is beginning to look a lot more like science fiction as computer companies develop the kinds of huge, color flat-panel displays that are featured in movies like Ray Bradbury's *Fahrenheit 451* and Paul Verhoeven's *Total Recall*. Two of Japan's largest electronics firms, Fujitsu and NEC, have separately begun talking about their research in gas plasma, bringing closer the day when electronic wall displays will give you big-picture access to the interactive applications of the converging computer and entertainment industries (Trends, October 27, 1992).



Gas plasma has potential for large screens because it's less expensive and easier to manufacture than today's state-of-the-art color active-matrix LCD panels. The largest LCD prototypes to date are 15-inch (diagonal) screens. If these displays ever do make it to market, they'll cost upwards of $100,000.

The color gas-plasma screens being talked about are much larger. Fujitsu is working on an 11-pound, 21-inch gas-plasma screen. And NEC's scientists have presented a paper that describes a 19-inch gas-plasma screen. Using hexagonal-shape pixels, NEC's first prototype is expected to have a very rough picture (320-by-240 pixel resolution), but 640-by-480 resolution is planned for the future. While the first displays will be smaller than today's large television screens, both companies hope to have screens ranging up to 60 inches within the next few years.

Although much of the world's display technology research has recently taken place in Japan, a number of American companies are getting back into the picture. Last year, Motorola formed Motif, with Oregon-based LCD maker In Focus Systems, to develop a passive-matrix LCD color panel using active-addressing technology. This new technology is expected to produce passive-matrix panels that perform just as well as more-expensive active-matrix panels. Motif's first products should come out later this year.

—*Christopher Barr*

Cheaper Ink

TO PUMP UP THE MARKET FOR INK jet printers, manufacturers are striving to lower the cost of consumables. Ink jets generally cost three to seven cents per page to operate, compared with two to three cents for laser printers.

The first technology to focus on lowering the cost of consumables is Epson America's new printhead. Today's ink jets use cartridges that contain both ink and printhead. When the ink runs out (after 500 to 1,000 pages), a new cartridge must be installed—even if the old printhead doesn't need to be replaced. But Epson's Multi-layer ACtuator Head (MACH), which debuted in the $449 Epson Stylus 800, lets you replace just the ink cartridge (which is rated at around 700 pages). The printhead itself has a life expectancy of 164,000 pages. The result is a per-page cost under three cents—in line with lasers.

At press time, other printer vendors were preparing to introduce ink jet technologies they also expected would lower the cost of consumables.—*Tin Albano*

Newton Clones?

APPLE'S PROPRIETARY GRIP ON ITS technology is one reason IBM-compatible PCs still outsell Apple computers ten to one. But as the company puts the finishing touches on its long-awaited Newton personal digital assistant, Apple may be opening up.

Sharp Electronics is helping Apple manufacture Newton devices and will sell products based on the technology. Apple made a deal with Siemens and its U.S. subsidiary, Rolm, to develop NotePhone products to integrate Newton into the telephone. Apple expects to make other agreements shortly, says Gaston Bastiaens, general manager of the personal interactive electronics division.

A full-blown Newton clone market a lá the IBM PC seems unlikely. But pieces of Newton are likely to show up in all kinds of appliances—a strategy similar to Microsoft's Modular Windows and software startup General Magic's Telescript and Magic Cap.

—*Mary Kathleen Flynn*

Illustration by: Scott Baldwin

Pipeline *By Robin Raskin*

Free the MHz 200!

If you haven't paid much attention to the political process in the last 20 years, it's time to dust off those protest signs. The Clinton Administration, hell-bent on using high-tech to bail us out of the America-in-decline syndrome, is moving on some important "information" issues for the 21st century. And, according to Congressman Edward Markey (chairman of the House Telecommunications and Finance Committee), as an industry, we aren't doing our share to insure that the right moves get made.

At a recent industry forum, Markey chided 500 of the industry's top PC entrepreneurs for acting like a bunch of high-tech cowboys who refuse to grow up and play Washington politics. Traditionally, our industry has been too busy being geniuses, creating nifty gadgets, and maybe even making money to pay too much attention to the government. The big players—the phone, cable and entertainment companies—are all seasoned pros at Washington's ins and outs.

The stakes are enormous. In 1968, an entire $10 million cellular industry was born when the FCC reallocated just 50 MHz of the radio frequency spectrum to the private sector. Earlier this year, Congress passed the Emerging Telecommunications Act of 1993, freeing up a walloping 200 MHz of the government-owned spectrum. With personal digitial assistants, wireless PCs, and interactive information services emerging, just how these frequencies will be used, and who will use them, is serious business indeed.

Markey is a self-appointed watchdog for the allocation process. He wants the traditional lottery replaced with an auction. And while an an auction would certainly be a source of revenue for an aching economy, Markey believes that revenues are only a part of the equation. He wants to make certain the wireless infrastructure we build lays the foundation for a high-quality, low-cost information network. As Congress begins its hearings to determine what criteria should be used for licensing the spectrum, its members want to hear from PC champions.

Thus far, the best—if not the only—organized industry representation is the Electronic Frontier Foundation. EEF is the creation of Lotus founder Mitch Kapor and Grateful Dead lyricist John Perry Barlow. The EEF wants to make sure that the infrastructure we create is open and affordable, and that it protects individual privacy—no mean feat when huge corporations want a ruling hand.

In a dollar-for-dollar duel, only Apple, IBM, and Microsoft have the resources to compete against the likes of AT&T, Sony, and Time Warner. One back-door approach is to make alliances in powerful places—an approach that could work for EO, General Magic, and other startups. Meanwhile, give Ed Markey a call and tell him how you want your information.

Robin Raskin is an executive editor of PC Magazine.

How Green is Your Green PC?

YOU'LL PROBABLY BE SWIMMING IN so-called "green" hardware later this year as companies and organizations embrace the Environmental Protection Agency's Energy Star conservation program. Last year, computer and monitor makers joined up. This year, printer manufacturers—including Hewlett-Packard, Kyocera, and Lexmark International—have announced support for the program (Briefs, March 30, 1993), as have video-board makers. The Video Electronics Standards Assocation is developing a protocol for video boards to communicate power-management information with monitors and CPUs. While this wave of enthusiasm for environmentally correct PC equipment is laudable, some vendors (IBM and Kyocera in particular) are taking the approach much further than others.

IBM's Energy Workstation sports two PCMCIA slots in the front.

Unlike many companies that are content merely to follow the EPA's low-wattage guidelines, IBM is taking a more fundamental approach in its Energy Workstation. Not only does the prototype product exceed the EPA spec, but it also takes user ergonomics and plastic waste disposal into account. The display is an (expensive) active-matrix flat-panel LCD that can stand free or hang off your office wall. Combine this with an extra-small CPU (which is also designed for easy plastic recycling) and you've freed up a significant amount of desk space while reducing the amount of potentially harmful VLF/ELF radiation.

The prototype also has two PCMCIA slots in the back.

In order to further save space and cut down on moving parts, the Energy Workstation also includes four credit-card-size PCMCIA slots. For those buyers who are more interested in functionality than they are in varying shades of green, IBM points out that the PCMCIA bus is soon to reach 32 bits and will provide seamless communication between desktops and portables.

Another truly "green" product is Kyocera's Ecosys printer, which won our 1992 award for Technical Excellence (January 12, 1993). It uses a long-lasting amorphous silicon photoconductor system that eliminates the need for disposable cartridges.

Doing away with the disposable cartridge does not just cut down on landfill, it also means a significantly lower per-page print cost and even greater paper handling capability: The Ecosys prints equally well on copier paper or recycled paper. The Ecosys line recently got a boost to 18 pages per minute (up from 10), as well as a barrage of new fonts and storage options.

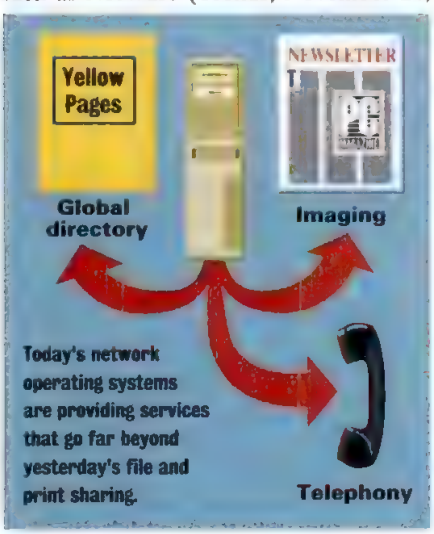
You'll want to pay close attention to the new energy-efficient products because they'll often save you money as they protect the environment. But be sure to get past the lip service to find the products that take energy efficiency and recycling seriously. —*Oliver Rist*

Photography by: Mark Lawrence

Advanced Services Come To PC Networks

NETWORKS HAVE MOVED WELL beyond the file- and print-sharing services that once provided their *raison d'etre*. Advanced services—such as global naming (also known as global directory), telephony (with the accent on the second syllable), and imaging—are rapidly making their way to the PC network environment.

The first of these advanced services to get integrated into the network operating system is global naming. Often compared to the Yellow Pages, a global directory lists all the users on a multiple-server network in one place. Banyan's VINES' StreetTalk was the first and is still considered the most elegant global naming service. Last year, Banyan began providing Enterprise Network Services for other environments, such as NetWare (Trends, November 24, 1992). Meanwhile, Novell has added its own NetWare Directory Services to NetWare 4.0 (First Looks, this issue). And Microsoft's Windows NT, scheduled to ship at mid-year, will let network administrators set up a system of *trusted domains* to provide enterprise-wide access to users.



Telephony services are intended to provide PC users with standard telephone capabilities (auto-dialing, call forwarding, conference calling, etc.). For example, you could attach a file made up of notes to a phone message. For NetWare users, Novell and AT&T are developing Telephony Services products as well as a set of application programming interfaces. But telephony services won't be limited to large networks. Personal digital assistants are likely candidates for integration with telephones: Apple and Siemens are working on Newton-based NotePhones (see "Newton Clones?," page 29, this issue).

Most recently, Novell announced Imaging Services for NetWare, a set of APIs for integrating, accessing, storing, and manipulating imaged data, such as scanned documents, photos, and drawings. Twelve corporate partners, the most well-known of which is Hewlett-Packard, are currently developing imaging-enabled applications for NetWare.

Microsoft Windows users may have to wait awhile for a full suite of advanced networking services. Dwayne Walker, Microsoft's director of Windows NT and networking products, says "Things like telephony score way down on the list of eight problems customers want us to solve within the next two to three years."

Microsoft is working on advanced services as part of its next-generation distributed object computing environment, a long-term project that's code-named Cairo and planned for the mid-1990s.

—Mary Kathleen Flynn

Plug and Play Peripherals

MICROSOFT AND INTEL HAVE PROposed a new specification for Industry Standard Architecture (ISA) cards that promises to extend ISA's usefulness for the next few years. Called "Plug and Play ISA," the spec will yield adapter cards that configure themselves automatically.

ISA, introduced in 1981 as an 8-bit standard in IBM's original PC, has withstood the challenge of IBM's Micro Channel Architecture (MCA) in 1987, and the so-called Gang of Nine's 1988 response, EISA, which extended ISA to 32-bits. While limited to a 16-bit data path, ISA systems still account for the lion's share of the market.

While both EISA and MCA have many advantages over ISA in terms of throughput and bus-mastering capabilities, MCA wins the ease-of-use prize for its automatic configuration process, which doesn't require you to set jumpers or switches. Installing EISA cards requires you to run a complex utility program. The Plug and Play ISA spec would operate more like the MCA installation.

The spec involves adding programmable ROM chips with a unique identification number for each adapter. Working under any operating system (a Microsoft product at minimum), the card would arbitrate interrupts, DMA channels, I/O ports, and memory conflicts, and would load device drivers as necessary. It would address the new bus connectors, such as PCMCIA, VL-Bus, and PCI, and would work with all types of adapters including SCSI, video, printers, and input devices.

While a dozen vendors have endorsed the proposal, a final spec isn't expected until later this year. If the details can be worked out quickly, the first boards are expected to be introduced by the end of 1993.

—Christopher Barr

Top Retail Software

Current ranking	Last issue	Product/ company
1	2	**Microsoft Access** *Microsoft Corp.*
2	8	**Quicken for Windows 2.0** *Intuit*
3	1	**TurboTax** *ChipSoft Inc.*
4	4	**Microsoft Windows 3.1** *Microsoft Corp.*
5	5	**Stacker 3.0** *Stac Electronics*
6	9	**Quicken 6.0** *Intuit*
7	6	**QEMM-386 6.0** *Quarterdeck Office Systems*
8	14	**WordPerfect 5.2 for Windows** *WordPerfect Corp.*
9	—	**MS-DOS 5.0 Upgrade Kit** *Microsoft Corp.*
10	12	**WordPerfect 5.2 for Windows Upgrade** *WordPerfect Corp.*
11	3	**Microsoft Money for Windows** *Microsoft Corp.*
12	10	**Microsoft Office for Windows 3.0** *Microsoft Corp.*
13	11	**WinFax Pro 3.0** *Delrina Technology*
14	—	**Procomm Plus for Windows** *Datastorm Technologies*
15	—	**Calendar Creator Plus** *Power Up Software*

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending March 13, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

Multimedia Off Parallel Port

WHILE SOME HARDWARE VENdors are concentrating on boosting the standard parallel port (Trends, April 13, 1993), others are unleashing a slew of new peripherals to plug into it without an adapter. The strategy makes good sense for devices that aren't dependent on performance.

Companies like Colorado Memory Systems (800-432-5858) and Micro Solutions Computer Products (815-756-3411) are shipping tape drives and portable hard disks that plug directly into the parallel port. Others, such as Gigatec (800-945-3002) and Data Spec (800-392-3336) are hooking up networks through the parallel ports of PCs.

Now adapterless multimedia devices have begun to hit the market. Logitech's AudioMan is an audio board, microphone, and speaker in a self-contained external device that plugs into the parallel port. The unit has limitations, however, such as not being able to play MIDI files or record from an external source.

Digispeech (916-621-1787) is capitalizing on Logitech's omissions with its new Port•able Sound Plus (see New & Improved, this issue), a 16-bit external sound system with speaker that fits in your briefcase. It supports standard multimedia sound files (MIDI and .WAV) and allows direct recording from a CD or tape player. InterActive (605-363-5117) offers SoundXchange, a complete sound digitizing and playback system in the guise of a telephone (see New & Improved, this issue). It attaches to your monitor and connects to the PC via the parallel port.

Novacor Desktop Video (800-486-6682) has a video capture adapter called FotoGRAF that accepts images from a video camera, VCR, or laser disk player, fits in your pocket, and attaches to a parallel port.

Connecting an adapterless CD-ROM drive to the parallel port seems an obvious next step, and Micro Solutions has introduced such a product. But its backpack CD-ROM drive fails to meet the Multimedia PC standard because it can't support a 150-KBps transfer rate using just 40 percent of the CPU's resources (First Looks, March 30, 1993). Marcus Miller, vice president of NEC Technologies' optical media and multimedia products, doesn't foresee MPC-compatible CD-ROM drives attaching directly to the parallel port. Ultimately, he feels, PCs will come standard with SCSI interfaces.

—Brad Grimes

Briefs

TO COMPETE WITH MICROSOFT WINDOWS NT, vendors are once again attempting to develop a standard interface for Unix. Hewlett-Packard, IBM, the Santa Cruz Operation, SunSoft, Univel, and Unix System Laboratories (recently purchased by Novell), are working together to create the Common Open Software Environment.

RESPONDING TO CUSTOMER CONCERNS, Digital Equipment Corp. has signed up Mitsubishi to be the second source for manufacturing its RISC-based Alpha chips. Mitsubishi's first products will be clones of Digital's chips, but later generations are expected to be different.

INTERACTIVE TELEVISION IS ALREADY BEING delivered to some U.S. homes. Parents and children in Birmingham, Michigan (a suburb of Detroit) can use the Interactive Channel, operated by the IT Network of Dallas on Booth Communication's cable system, to interactively review homework assignments and school projects and communicate with teachers.

TO HELP SOFTWARE DEVELOPERS AND resellers recycle and reuse obsolete software and diskettes, the GreenDisk Co. has been formed (206-868-7231). The company will disassemble software packaging, distribute some materials to recycling processors, and return reusable parts to the publisher.

YOU CAN NOW SEND E-MAIL TO THE WHITE House (on America Online, CompuServe, the Internet, and MCI Mail), but unfortunately, the White House is responding with traditional mail via the U.S. Postal Service.

—Mary Kathleen Flynn

Tax Bottleneck

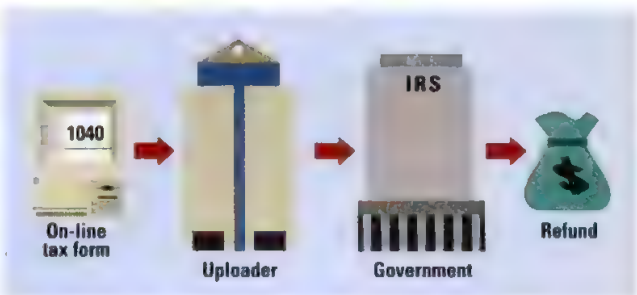
WHILE THE ANNUAL RITUAL OF filing your federal tax return can be made easier using a computer, many of those tax-program users who filed electronically added several weeks to the time it took to get their refunds.

All of the popular tax preparation programs have an option to file returns electronically. The advantage of filing electronically is threefold: First (in theory, at least), you get your return to the IRS faster than if you mailed it. Second, the IRS can copy your file to its computers—thus minimizing transposition, addition and other keying errors. Third, if you indicate a bank account number, the IRS will deposit your refund directly into your account, just as many companies distribute employee paychecks. Electronic filing and direct refund deposit should trim from eight to three weeks the time it takes the IRS to process a return and issue a check. But this year the process has gone awry for Chipsoft, maker of TurboTax.

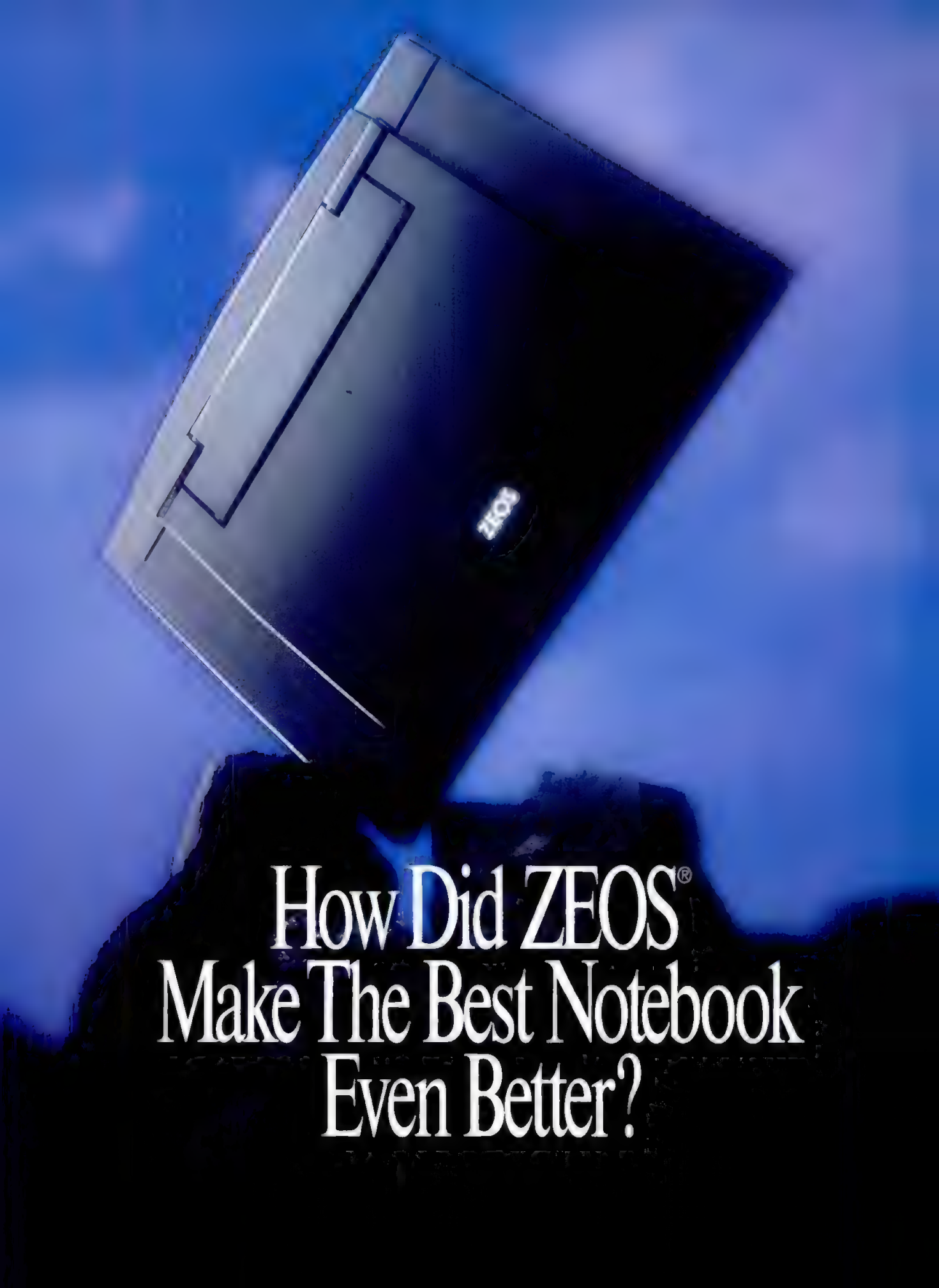
Since the general public can't upload returns directly to the IRS, Chipsoft bought Speed>Filing, a Minnesota company authorized by the IRS to upload returns. But Chipsoft and Speed>Filing woefully underestimated the number of electronic filers and were quickly overwhelmed with users wondering where their refunds were.

Irate TurboTax customers peppered Chipsoft's support forum on CompuServe with complaints of lost returns. Support lines have been jammed, and when users did get through, the company was so overwhelmed it couldn't give an accurate answer. A spokesperson from Chipsoft acknowledged the problems and said Speed>Filing will be moved to the company's headquarters in California in time for next year's tax season. This reporter hopes to have received his refund by then.

—Christopher Barr



One reason electronic filing sometimes slows down the tax refund process is that there are too many steps.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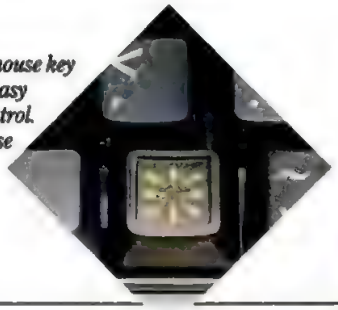

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Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
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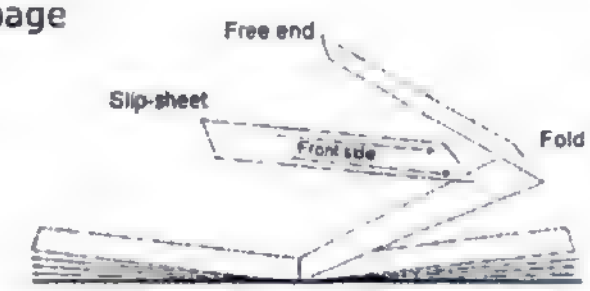
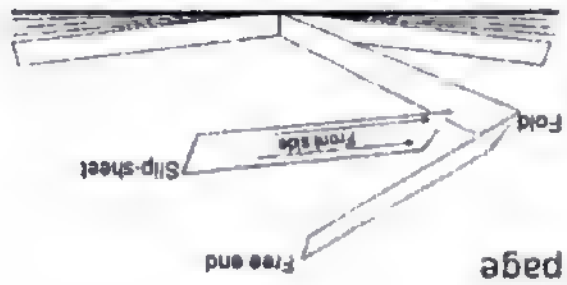
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



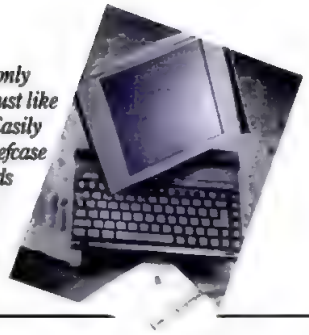
Inverted Back

1. Follow instructions on the other side

GbsFlipBack-0018

Back

1. Follow instructions on the other side



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Processor	Intel 386SL	Chips & Tech. F8680	Intel 386SL
Processor Speed	25MHz	10MHz	20MHz
RAM	2MB to 10MB	1MB to 3MB	2MB to 10MB
Hard Drive	80MB	40MB	60MB
Screen	VGA Backlit	CGA Backlit	VGA Reflective
Runs Windows	Yes	No	Yes
Built-in Pointing Device	Yes	No	No
Footprint	9.7" x 6.1"	9.8" x 5.9"	11.0" x 7.8"
24 Hour Support	Yes	No	No
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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

A New Era in Networking

NetWare, Version 4.0: Only Large LANs Need Apply

BY FRANK J. DERFLER, JR.

The first question you'll ask is "Where is SYSCON?" The absence of the comfortable management utility used by tens of thousands of Novell NetWare administrators brings home the differences between Novell's latest release, NetWare Version 4.0, and its predecessors.

NetWare 4.0 isn't an upgrade for Novell's popular NetWare 3.11—NetWare 3.2 waits in the wings to play that role. Rather, NetWare 4.0 wraps the core NetWare file and print services with a new architecture that is aimed at the multiserver market. The new utilities included with NetWare replace SYSCON and enable a new naming technology.

Our advice: If you have six active NetWare 3.*x* file servers, start considering the change to NetWare 4.0. If you have a dozen servers, the management benefits of this release are persuasive. However, if you only have a few servers, are happy with SYSCON, and have your network login scripts working the way you want them, you won't have much interest in spending $4,695 for the 25-user version of NetWare 4.0.

The first change that you'll notice in NetWare 4.0 is in its packaging. The standard price brings you a CD-ROM holding the software and the documentation. If you want the floppy disks or the printed documentation, there's an extra charge. So either your server has a CD-ROM, or you must pay for the floppy disks.

The major changes to NetWare 4.0's architecture start with a naming service that globally positions each user and resource in the network. In practical terms, this means each user logs in only once instead of logging in to every server. NetWare 4.0 also includes file data compression so your server's drives can hold nearly twice as much data—a feature that can offset the price of the software by avoiding the need for a

Continues on page 38

The Old vs. the New

NetWare, Version 3.11	NetWare, Version 4.0
Server-by-server naming	Global naming
No active security auditing	Active security auditing
No imaging option	Imaging available
Basic Windows utility	Advanced Windows support
No packet burst	Packet burst option

Illustration Software

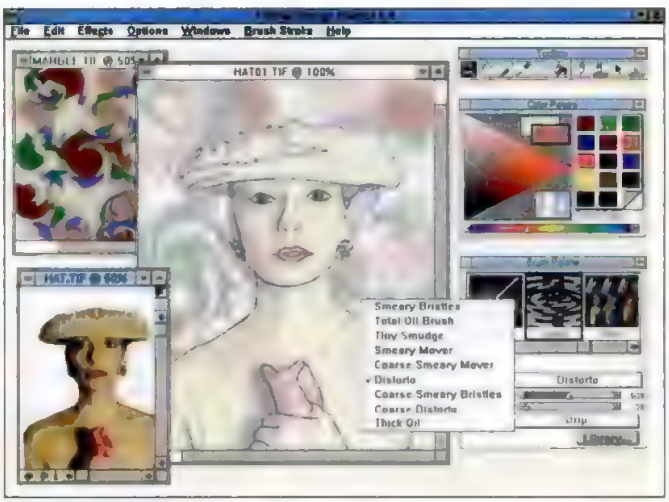
Updated Fractal Design Painter Dazzles

BY LUISA SIMONE

Last year, the introduction of Fractal Design Painter for Windows changed the way electronic art was made. Fractal algorithms that mimicked natural media such as watercolor or oils and an affordable price of only $399 made this paint program an instant hit. But despite the overwhelming enthusiasm, several legitimate criticisms were leveled against Version 1.2.

Version 2.0 of Fractal Design Painter addresses the previous version's shortcomings with innovative technology and without compromising the essential nature of the program.

One of the most common complaints about Painter 1.2 was that in its zeal to mimic traditional media, it often eschewed the benefits offered by the electronic media, such as the ability to edit an image globally.



LIQUID MEDIA: *A new marbling tool creates background swirls.*

Version 2.0 lets you apply a host of image-editing filters to your pictures. You can even acquire images directly from a scanner via Painter's new support for the Twain protocol.

Many of the filters—such as Equalize, Sharpen, or Motion Blur—are now standard fare for raster-based programs. But other functions, unique to this program, still surprise and delight. For example, the Apply

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Photography by: Thom O'Connor

NetWare 4.0

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hard disk upgrade. Upcoming versions of NetWare 4.0 for Unix and NetWare 4.0 for OS/2 will complement the native version to meet corporate needs.

On the client side, the new NetWare shell called VLM.EXE handles the global naming requirements. VLM.EXE can look like NETX so it works with NetWare 2.*x* and 3.*x* servers. A much-needed innovation allows you to load and unload the client software under Windows. The client software comes with drivers for approximately 150 adapters, and it runs over Microsoft's NDIS (Network Driver Interface Specification) if you have a rare adapter that doesn't use Novell's ODI (Open Data Link Interface). The client software also includes Novell's burst client support that improves throughput in some applications. A subset of Saber Software's Saber Menu System replaces NetWare's MENU.EXE.

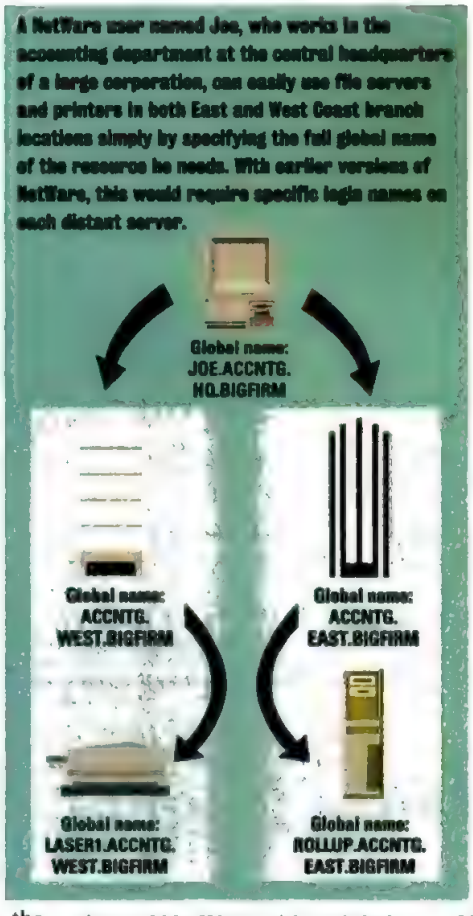
INSTALLATION AND SETUP

You can install the network software in less than 15 minutes, including the time you spend reading the documentation. The upgrade utility built a 4.0 server over our existing 3.11 server and retained the 3.11 user and resource names. If the same person has accounts on several different 3.11 servers, you'll have to give that person a single global name manually.

You'll use a backup to restore the data files after the upgrade is completed, so be certain your restore function works before you start the upgrade. If you select the file-compression option, NetWare 4.0 will immediately give you more disk space to work with, but the amount of disk space you gain depends on the nature of the files.

While the installation itself is quick, properly naming the server during setup can take days of study. The new NetWare Directory Services (NDS) replace the server-by-server management process of earlier versions of NetWare with a global naming scheme in which all servers know the rights of all users. When you answer the naming questions on any server, you must have the whole structure in mind and understand how the particular server relates to all others.

How Global Naming Works



Planning the NDS naming structure is similar to planning the layout for all the directories and subdirectories on a hard disk before you load the data. NDS uses the same kind of root and tree organization, and you can make as many layers of branches as you need. But the top-level directories are key. The structure you design should have enough layers so you can add servers in a logical sequence, but you must keep the number of layers down to a minimum, if possible, to reduce complexity.

For example, the name LASER.ACCOUNTING.4TH FLOOR might work for an organization that will never extend the network beyond one building, but another organization might need a name such as LASER.ACCNTG.4THFLOOR.NEW-YORKNAMERICACOMPANY.BIGFIRM. for the same resource. Fortunately, NDS gives you the flexibility to designate alias names that represent the longer identification. In other words, the same printer might be known by the alias NYLASER in this organization's accounting departments around the world.

The global nature of the NDS naming scheme also drives other changes. For example, the servers now recognize time zone changes when they update the time. And the NDS traffic is encrypted with a sophisticated public key encryption standard so you can keep security tight.

You can intermix NetWare, Version 3.11 and 4.0, servers on the same network but you'll have to manage them separately. This is enough motivation to upgrade all the servers. In a mixed-network environment, you'll encounter a tricky incompatibility in the underlying Ethernet frames coming from a 4.0 client. The drivers in early versions of NetWare conformed to an Ethernet protocol that has since undergone change. Unlike Netware 2.*x* and 3.*x*, Version 4.0 conforms to the current IEEE 802.2 standards. If you want the NetWare 4.0 client to be compatible with pre-4.0 servers, you must make sure that a "frame=" line in AUTOEXEC.NCF loads the old 802.3 drivers.

STRATEGIC DIRECTIONS

Adopting NetWare 4.0 is a strategic corporate decision. Retailers and administrators will need training to learn how to set up and support the system, and changing the naming service will cause turmoil. Novell announced other strategic options for NetWare 4.0 including the ability to run NetWare Loadable Modules (NLMs) on PCs, wiring hubs, and other devices across the network, and an imaging service for handling large image files.

NetWare 4.0 has memory management and protection features that make it more efficient at running NLMs. Adopting NetWare 4.0 is surely a big step, but if you have a big network, the product has a lot of appeal. □

FACT FILE

NetWare, Version 4.0
Novell Inc., 122 E. 1700 South, Provo, UT 84606; 800-453-1267; 801-429-7000, fax: 801-429-5373

List price: 5 users, $1,395; 10 users, $3,195; 25 users, $4,695; 50 users, $6,295; 100 users, $8,795; 250 users, $15,695; 500 users, $26,395; 1,000 users, $47,995. Upgrades: for recent Version 3.11 buyers, the difference in price.
Requires: 8MB RAM in server, 25MB hard disk space in Volume Sys:, 5MB DOS partition on server, CD-ROM drive recommended.
In short: Novell's newest release of NetWare is aimed at installations with many servers. The new NetWare Directory Resources structure provides a global naming service for both people and resources. Adopting a NetWare 4.0 network architecture is a big strategic step, but the move away from server-by-server management can be worth the investment for organizations with more than a few servers.

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Fractal Painter

CONTINUED FROM PAGE 37

Lighting option lets you create ambient and spot illumination effects automatically. Simply position the spots, choose white or colored light, adjust the exposure, and sit back as Painter creates the glare of a flashlight or the caress of a sunbeam.

Other automated painterly effects include Auto Van Gogh (which clones an image using random Vincent-like brushstrokes), Blobs, Marbling, and Glass Distortion.

These effects are truly sophisticated, but very easy to use. Several of the filters—notably Glass Distortion and Apply Surface Texture—can take advantage of the currently selected paper to add a tactile dimension. And dynamic preview windows in dialog boxes give you instant feedback on the current image-editing settings and practically guarantee that you get the effect you want.

All of Painter's image-editing functions can be applied either to an entire picture or to a selected area. And in response to user requests, Painter 2.0 offers vastly improved selection and masking tools.

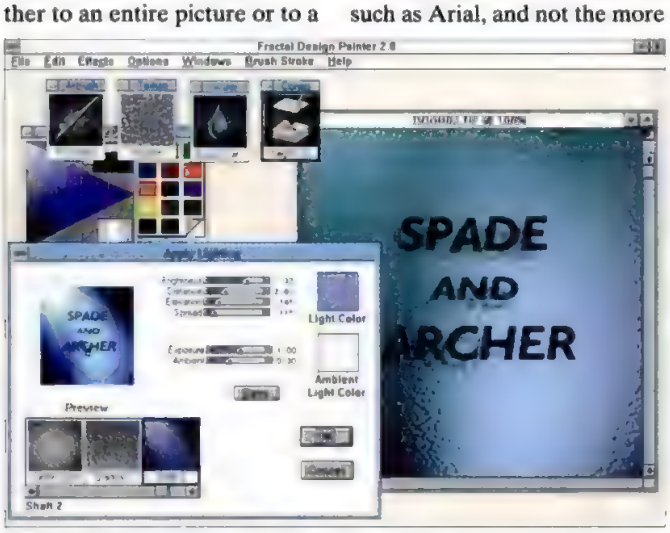
The selection tool is still a rectangular marquee, but you can do more things with a selection area than ever before, including rotating, skewing, and flipping the contents.

NEW FRISKET TOOLS

The changes to Painter's friskets (or masks) are much more substantial. Friskets can now be reshaped and resized, can be drawn with straight (as well as free-form) lines, can be imported from external .EPS files, and can even use TrueType and Type1 fonts as a source of vector information. Indeed, friskets are the only way to incorporate text into a Painter document.

This approach gives you a great deal of flexibility. Like all other friskets, multiple text friskets can be active at the same time, can be combined with other nontext friskets, and can be made into a positive or negative mask. But this feature definitely needs fine tuning, since you cannot apply any text formatting to an imported font. Nor can you import more than one font outline at a time.

Most annoying is the way Painter requires you to choose a font. TrueType fonts are represented by generic font names, such as Arial, and not the more descriptive type variants (such as Arial Bold Italic). Importing Type1 fonts exhibits its own quirks, because instead of true font names such as Gill Sans Bold Italic, you must decipher the actual filename, such as gnbi___.pfb.



FROSTED GLASS: *Spotlights and distortion effects created this look.*

FASTER THAN PICASSO?

Version 2.0 of Fractal Design Painter ran almost flawlessly on our 66-MHz 486. The only problem was related to friskets. In 24-bit mode, friskets generated a lot of screen artifacts that could only be cleared by closing and reopening a file. Switching from 16 million to 32,000 colors circumvents the problem, but only new video drivers from the hardware makers will solve the problem.

Painter will run on slower machines. In fact, Version 2.0 requires 2MB less memory than its predecessor. But the simple truth is that fractals and bitmaps are processor- and display-intensive. Two of the new image-editing filters, Apply Lighting and Blobs, work only with a math coprocessor. And if you are running Painter on a 386SX, be prepared to wait for complex brushes to render.

The immediacy of Fractal Design Painter's tools is wonderful for beginners. Within minutes of starting the program you'll feel comfortable picking brushes, colors, and paper textures. Painter 2.0 makes it easier to work on this level by providing more paper textures and brush variants than ever.

Some of the new brushes, like the Dodge and Burn editing tools, are built upon technology that has always existed within Painter. Other brushes, like the Liquid Media tools that mimic traditional marbling techniques, represent a new class of electronic painting functions.

Version 2.0 concentrates on the needs of power users with a revamped interface that makes customization easier. The most intriguing new options are the Brush Stroke Designer and Brush Looks palettes.

The Brush Stroke Designer is a feedback window that shows you a sample brushstroke. It changes in response to the actions you take on other palettes—such as Brush Behavior, Brush Size, and Expression palettes. So instead of grappling with the concepts of Dab Location Variability or Resaturation, you can simply move the sliders and see the effect. Saving the brush strokes lets you access them again from the Brush Looks palette.

Professional illustrators will be thrilled by Painter's ability to optimize images for video output or for commercial printing presses. Straightforward menu choices instruct Painter to use only those colors that are within the gamut of the CYMK, NTSC, or PAL color systems. And Painter can now save images as preseparated .EPS files using the .DCS format, in addition to the standard .BMP, .PCX, bitmapped PICT, .TGA, TIFF, and proprietary .RIF formats.

So much of Painter 2.0 has been augmented or improved that it's impossible to describe all of the new features. You're bound to discover many wonderful new functions.

In a market where increasingly standardized technology has blurred the boundaries between image-editing products and paint programs, Fractal Design Painter, Version 2.0, remains in a class by itself. This program continues to employ technology in unique and innovative ways; yet it never lets the technology interfere with its fluid, elegant, and truly artistic set of tools. □

FACT FILE

Fractal Design Painter for Windows, Version 2.0

Fractal Design Corp., 335 Spreckels Dr., Suite F, Aptos, CA 95001; 408-688-8800; fax, 408-688-8836

List price: $399, upgrade, $79
Requires: 4MB RAM, Microsoft Windows 3.0 or later. 16-bit or 24-bit graphics adapter and pressure-sensitive digitizing tablet recommended.
In short: Powerful new image-editing functions give Fractal Design Painter all of the effects you need. The natural media paint tools are better than ever

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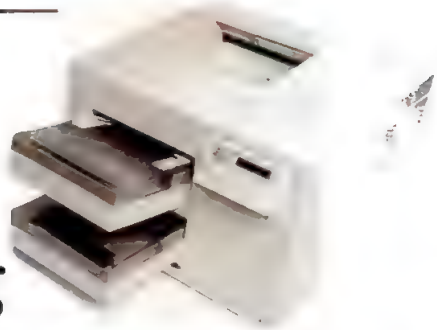
■ Laser Printers

HP LaserJet 4Si: High Resolution Network Printing



SHARPER IMAGE: *The HP 4Si features 600-dpi resolution.*

BY ALFRED POOR

Hewlett-Packard has expanded its new LaserJet 4 series of printers with the addition of the new LaserJet 4Si. Like the IIISi it replaces, the new model is a 17-page-per-minute printer designed for network or other shared use. Like the LaserJet 4, it ups the output ante to 600-dot-per-inch resolution, with enhanced resolution for smoother text and line art.

The LaserJet 4Si appears two years after HP's first shared printer, the IIISi. In keeping with HP's marketing style, the new model offers more for a lower price. The base model carries a list price of $3,749, compared with the IIISi's original price of $5,495 (now $3,999). We looked at the 4Si MX, which includes Adobe PostScript Level 2 and carries a list price of $5,499.

Both versions of the 4Si come with enhanced PCL 5 support, a pair of 500-sheet paper trays, and a 25-MHz Intel RISC processor driving the 17-ppm print engine. Both also have a Bi-Tronics parallel interface as standard, which is up to 10 times faster than a typical Centronics parallel port and also supports bidirectional communication between the computer and the printer.

This interface makes it possible for the printer to send information about its configuration to the computer; the HP Explorer utility takes advantage of this feature so that you can interact with the printer's configuration directly from your computer.

User-installable paper-handling options include a duplexer that lets you print on both sides of a sheet of paper, a powered envelope feeder with a 100-envelope capacity, a replacement lower tray that holds 1,500 sheets instead of the standard 500 sheets, and a 2,000-sheet output stacker.

Both printers come with 35 Intellifont scalable fonts as standard, plus support for the ten TrueType fonts included with Microsoft Windows 3.1. The 4Si MX adds the standard 25 PostScript outline fonts as well. The 4Si comes with 2MB of memory, expandable to 34MB, while the 4Si MX has 10MB standard, expandable to 26MB. With PostScript installed (standard in the 4Si MX, an option with the 4Si) the printer can automatically switch language modes based on the incoming data. Unlike some auto-sensing printers, the 4Si will not lose downloaded fonts or macros when it changes modes. Both printers also have two font cartridge slots.

GRAPHICS SAMPLE: *Smooth halftone images.*

Our wretched species is so made that those who walk on the well-trodden path always throw stones at those who are showing a new road - Voltaire
Normal **Bold** *Italic* Compressed Super Sc

TEXT SAMPLE: *The letters look crisp and clean.*

The HP 4Si MX comes with a LocalTalk and an HP JetDirect network interface. The JetDirect Ethernet interface accepts data at speeds up to 350K per second and can respond automatically to different protocols, switching between ten major network operating systems. NetWare users can use utility software to inquire about and change the configuration. Network administrators will also appreciate the fact that there is a password-protected configuration feature.

In terms of performance, the LaserJet 4Si is about as fast as the IIISi. Under PCL, it turned out 14.8 pages per minute on PC Magazine Labs' standard Text Speed test, and 4.0 graphics pages per minute on the Graphics test. Under PostScript, the 14.7-ppm text speed was essentially the same as the PCL speed, but the graphics result was only 0.89 graphics pages per minute.

This slower time is in large part a result of the fact that the test was run with a 600-dpi image instead of the 300-dpi image for PCL, so there was four times as much bitmapped data to send to the printer.

The 600-dpi output does make a huge difference in the output quality; lines are crisper, and halftone images are smoother. With HP's Resolution Enhancement Technology (RET) enabled, it's nearly impossible to see any jaggies on text or line art, even under magnification. RET adjusts the dot size and placement to smooth angled and curved lines. This provides results that are equivalent to a resolution much higher than 600 dpi.

Output from the 4Si should meet the needs of most users who want to create camera-ready copy for reproduction. The RET can create some problems with halftone images, however; there was a noticeable "posterization" in some grayscale areas of a test image.

The LaserJet 4Si and 4Si MX have raised the stakes in the shared printer game. Higher resolution output, a wide range of paper-handling options, and faster I/O ports with more intelligence—and all for a lower price than the IIISi—make this a powerful bargain for anyone who needs high-quality output quickly.

• List price: *HP LaserJet 4Si, $3,749; LaserJet 4Si MX, $5,499; Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900, 208-323-2551.*

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■ Programming Language

Visual C++: Tools for the Expert Windows Developer

BY SHERYL CANTOR

If you thought Microsoft Visual C++, Version 1.0, was going to be just like Visual Basic but with C++, you'll be surprised. Visual C++ comes with some impressive visual development tools, but you still must know Windows programming.

The Standard Edition of Visual C++ ($199) supports only Windows development and is the upgrade to Quick C for Windows. The Professional Edition ($499) is the upgrade to Microsoft C/C++, Version 7.0 (C7). There will be no package called C8; Visual C++ *is* C8.

THE VISUAL WORKBENCH

Unlike C7's Programmer's Workbench, the new Visual Workbench (VWB) is Windows-hosted and truly integrated. The new visual tools—App Wizard, Class Wizard, and the superbly designed resource editor, App Studio—all can be accessed from within VWB. Some of the integration is accomplished through a virtual device driver, so you won't be able to run it from within protected-mode operating systems such as OS/2 or NT. An NT version is in the works.

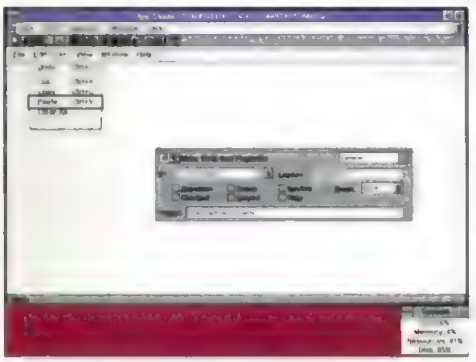
The built-in editor and debugger are borrowed from Quick C for Windows. The integrated debugger is only for Windows programs, but DOS and Windows versions of CodeView can be launched from VWB. The editor is a step down from C7: You can no longer do multifile searches, create macros, bring up help by highlighting a keyword, or perform block editing. However, it does have color syntax highlighting.

One welcome feature of VWB is background compilation. Compilation times, though improved, are still relatively slow, but at least you can do something else while you wait.

BUILDING A WINDOWS APP

All the visual tools in Visual C++ are for Windows development. You can generate DOS applications if you have the Professional Edition, but that's not where Visual C++ shines. The App Wizard and Class Wizard rely on the Microsoft Foundation Class (MFC) library, which encapsules most of the Windows SDK into a C++ class structure. If you want to code in straight C or write directly to the Windows API (application programming interface), the Wizards will be of no use.

The App Wizard lets you select basic functionality such as Printing and Previewing and Context Sensitive Help, and then generates MFC-based code. One new feature of MFC, Version 2.0, is the use of Visual Basic custom controls. (Only controls written to the VBX, Version 1.0, API are supported.) The Class Wizard lets you specify how interface objects respond to user input, then generates more MFC-based code.



RESOURCE EDITOR: *App Studio lets you design menus with the help of a working prototype.*

While it's easy to generate a skeleton application, customizing it takes a thorough knowledge of C++ and MFC. The Wizards are good teaching tools and are tremendous productivity boosts for those well-grounded in C++ and MFC, but they do not shield the user from Windows' thorny innards; they won't get beginners up and running fast like Visual Basic will.

The real shining star of Visual C++ is the App Studio; this is a dream resource editor. First, unlike the resource editor in C7, it can handle *any* resource. And it's entirely visual. With App Studio, creating a menu goes from tedious to fun. A functioning prototype of your menu is displayed so you can see how it looks as you build it. The Properties box lets you set accelerator keys and other resource properties. When you're done creating your menu or other resource, you can launch the Class Wizard from within App Studio to bind the interface objects to code.

HUNGRY FOR MEMORY

Don't even think about running Visual C++ if you have less than 8MB of memory. While 4MB is the stated minimum, this is the minimum needed to compile something; it is not the minimum you need to use any of the features. For best performance, 12MB of memory is required.

But look out if you've been using a computer with an ISA bus, a SCSI controller with an Adaptec ASPI4DOS driver loaded, and over 16MB of RAM. Visual C++'s demanding use of memory will quickly reveal that the driver can address no more than 16MB; your system will crash when you try to compile. You will have to either remove the driver (and sacrifice usage of CD-ROM or tape drives), or remove the memory over 16MB.

WHAT'S THERE, WHAT'S NOT

Some pieces included with C7 are missing from Visual C++: There's no documentation for pen and multimedia programming and no SETUP toolkit for creating an installation program. If you like have C7, don't throw out your old manuals; you will only receive manuals for features that have changed.

Visual C++ isn't "Visual Basic with C++," but it does provide powerful visual tools for C++ Windows development. The special upgrade prices (from Microsoft or competitive compilers) make Visual C++ highly affordable. If you're a Windows programmer, the App Studio alone makes it worth the upgrade price. □

FACT FILE

Microsoft Visual C++, Version 1.0
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-992-3675, 206-936-8661; fax, 206-936-7329

List price: Professional Edition, $499, Standard Edition, $199, C7 upgrade to the Professional Edition, $139; competitive upgrade to the Professional Edition, $199; Quick C for Windows upgrade to the Standard Edition, $79; competitive upgrade to the Standard Edition, $99.
Requires: 8MB RAM (12MB recommended), 50MB to 70MB hard disk space (full installation), Microsoft Windows 3.1 in Enhanced mode
In short: Visual C++ does require Windows programming expertise, but for the professional developer, its set of visual tools makes programming faster and easier
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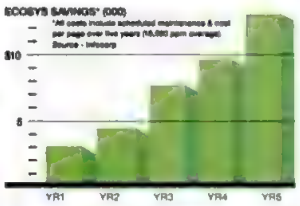

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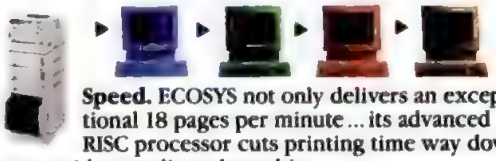

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OS/2 Spreadsheets

New 1-2-3 for OS/2 Lacks Best New Lotus Features

BY CRAIG STINSON

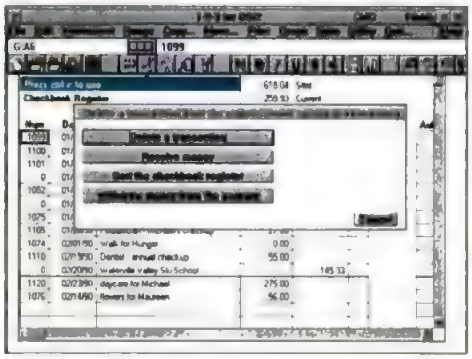
The recent arrival of Lotus 1-2-3 for OS/2, Release 2.0, underscores Lotus Development Corp.'s commitment to produce a complete line of apps for IBM's underdog operating environment. Lotus has shipped an update to its Freelance Graphics for OS/2, and it promises OS/2 versions of cc:Mail and Ami Pro later this year.

Despite its newly styled name, the $495 1-2-3 for OS/2, Release 2.0, (which is also available in a $595 server edition) is only a modest update of 1-2-3/G, the OS/2 spreadsheet that Lotus unveiled in 1990.

Lotus 1-2-3 for OS/2 offers none of the user-interface enhancements that were featured in the just-released Improv (First Looks, April 27, 1993) and that will undoubtedly grace the next Windows version of 1-2-3. And the much-touted Chronicle technology, which will bring workgroup support to 1-2-3 for Windows' next release, is nowhere to be seen.

For those who prefer OS/2, however, Release 2.0 does have some inducements to justify its $150-upgrade price. Chief among them are multithreaded (hence faster) printing, a set of SmartIcons, and some new application development features. Release 2.0 also shares its charting engine with Freelance for OS/2, simplifying the creation of hot-linked presentations. A Freelance slide that incorporates a 1-2-3 chart will be updated whenever the underlying data change.

The improvements for developers consist of ten new macro verbs plus an API for linking 1-2-3 macros to DLLs written in C. The additions to the macro language allow the programmer to create custom menus and dialog boxes. Macros based on the older {menubranch} and {menucall} instructions are still supported, but with the new commands the programmer can create custom applications that take better advantage of OS/2's interface.



32-BIT: *1-2-3 for OS/2 has SmartIcons.*

Other enhancements include drag-and-drop printing and shredding, automatic fit-to-page print scaling, and the ability to paste graphic images on the worksheet. There are no drag-and-drop facilities for reorganizing worksheets, however, and the drawing layer comes with no tools.

Lotus says it's in this game to stay, but its effort as judged by this release seems a bit halfhearted.

• List Price: *Lotus 1-2-3 for OS/2, Release 2.0, $495.* Requires: *4MB RAM, OS/2 2.0 or later. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500; fax, 617-693-4551.*

Circle 425 on reader service card

Multimedia

Rapier XTV Puts Full Motion On-Screen

BY JAMES KARNEY

If you've been looking for a way to use real-time full-motion and still video with 24-bit true-color graphics under Microsoft Windows, VideoLogic's Rapier XTV may be the solution. The $995 kit—which includes the card itself, RCA and S-Video cables, an MCI control panel, and VideoSnap software—works with VideoLogic's $2,195 Rapier 24 display adapter (First Looks, July 1992), letting you view, enhance, and capture video from NTSC, PAL, and Kodak Photo CD sources.

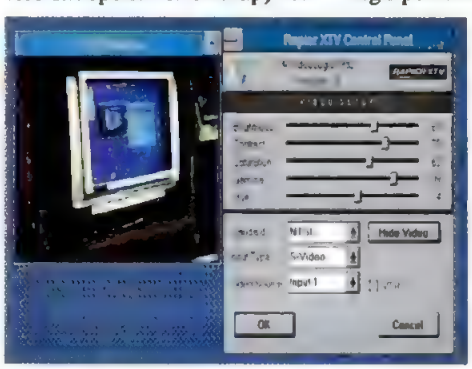
As a bonus, you can enjoy 1,152-by-882 resolution with 16.7 million colors (if you've got the monitor for it), a pan-and-zoom feature, and the ability to enlarge the video window up to eight times the normal size.

Installing the card involves attaching it to the Rapier 24 via three sets of dual-pin connectors. You have to be careful since there are no edge guides, and it's a bit difficult to see if all the pins are lined up. Then you attach the cables and install the drivers and software. Most users should have no problem getting the adapter running.

The TI-34020–based Rapier isn't today's fastest performer, but it's still quick. We used the XTV and the Rapier software to show, capture, and tune images from both live video and a hi-8 prerecorded tape.

Those new to image-correction will find the instructions on editing both thorough and easy to understand. Correction controls include brightness, contrast, saturation, hue, and gamma. All modifications are made using interactive slider controls with numeric readouts. The VTR button enables an auto-tracking function that cleaned up skew on our test tape.

We copied video captures to the Clipboard and pasted them without difficulty. Images can be saved to disk in 24-DIB (Device Independent Bitmap) format. Leaving the video running while working in other applications, even with the window partially in view, caused no performance problems. As an analog device, the XTV doesn't work with Video for Windows, though it's compatible with a wide range of multimedia editors.



HIGH-RES: *Video up to 1,152-by-882.*

The XTV, coupled with the Rapier 24 ($2,995 if purchased together), is expensive for the casual user, but those who need full-motion video capability, fast high-performance, and the ability to image 3-D objects will find that this combination makes an almost perfect picture.

• List price: *Rapier XTV, $995.* Requires: *ISA or EISA 386-based system or better, 1MB hard disk space, Microsoft Windows 3.1, Rapier 24 display adapter ($2,195). VideoLogic Inc., 245 Cambridge St., Cambridge, MA 02142; 800-578-5644, 617-494-0530; fax, 617-494-0534.*

Circle 421 on reader service card

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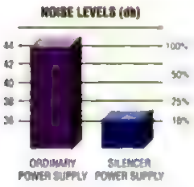

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	Desktop	Tower	Monster
Motherboard Capacity:	1	1	2
Power Supply Capacity:	1	1	2
Exposed Drive Bays:	3	6	13
Total Drive Bays:	5	8	18
Cooling Fans:	2	3	6
Filtered Air Inlet:	Yes	Yes	Yes
Lockable Front Door:	Yes	No	Yes
Professional Controls	Yes	Yes	Yes
All-Steel Construction:	Yes	Yes	Yes
Beige or Black Finish:	Yes	Yes	Yes
Made in USA:	Yes	Yes	Yes

SOLID-STEEL DESKTOP CASE **$295**
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SOLID-STEEL MONSTER CASE **$895**

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It's a fact. 486 chips run hot, often exceeding 185°F! Now, you can cool your 486 to a safe 85°-95°F with our popular **CPU-Cool**. It prevents random system errors and other heat-related problems. Consists of a mini-fan embedded in a sculptured heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!

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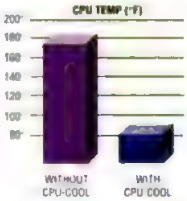

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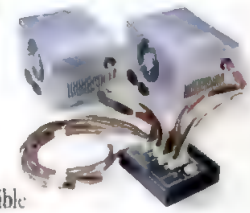

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CIRCLE 080 ON READER SERVICE CARD

■ **Notebook PCs**

NEC Versa 25C: Lasting Color

BY JULIE COHEN

Nobody wants to outgrow a notebook PC in a few months. At last, manufacturers like AST, Zenith Data Systems, and now NEC are emphasizing investment protection by creating versatile systems that can grow with users' needs. A host of features and qualities, from a removable screen to excellent expandability and long battery life, make the $4,269 color NEC UltraLite Versa 25C a good example of this trend.

You should consider the 6.8 pound, 25-MHz 486SL-based Versa for its graphics capability—most impressively, its replaceable 9.5-inch active-matrix screen. You can upgrade from a mono unit (priced about $1,200 less than the color notebook we tested) to color, or add a pen screen when one becomes available later this year.

Even more intriguing, the display panel can be reattached with the screen facing away from the unit, a convenient feature for on-the-road demos. Though AST came out with a removable screen several months ago, NEC's implementation is more convenient and more versatile. Rather than screws, the Versa has two wing-like tabs that release the screen.

FORWARD THINKING: *The upgradable Versa.*

For all this flexibility, the video system is fast, too. Thanks largely to Intel's 486SL architecture, NEC's local bus video subsystem ran rings around other 486-based notebooks. The Versa's 4.47 million Graphics Winmark score is more than double that of the Compaq LTE Lite 4/25C, and well above the scores of the Toshiba T4400C (486SX/20) and the AST PowerExec (486SL/25). Because Intel's 486SL has all the features of a 486DX, the Versa 486SL/25 also outperformed 486SX/25-based notebooks in processor and disk tests.

By using 3.3-volt components, a powerful 3.4 amp-hour battery, and the low-power 486SL chip, the Versa was able to last far longer than many other color notebooks: 5 hours 2 minutes on our ZDigit test, compared with 3 hours 48 minutes, the average battery life of 486SX/25-based notebooks tested at PC Labs. Users who don't need an internal floppy disk drive can nearly double that life by inserting a second battery in the floppy drive bay.

Besides the reversible screen, the system has a removable hard disk, and a Type 3 PCMCIA slot for additional networking, modem, and storage options.

Our test Versa came with 4MB of RAM, a 120MB hard disk, and a 9,600-bps PCMCIA modem—one of five cards the company is labeling for use in the Versa's Type 3 PCMCIA slot. In an industry first, the slot has hot-swap capability: You can insert and remove cards without powering down.

NEC's line includes a 20-MHz 486SL unit, and will include the 33-MHz SL when the CPU is available. Other options include 4-, 8-, and 16MB RAM upgrades, and 80MB and 180MB hard disks.

The system's main shortcomings are its bulky, 1.3-pound AC adapter and its lack of a built-in pointing device. Instead, it comes with a Microsoft Ballpoint mouse.

Getting service on the road can be somewhat problematic. With that in mind, NEC developed its UltraCare program. You can register the system and receive a year of international service and support in 24 countries, 24-hour toll-free reporting of problems, and overnight repair service.

With the Versa's upgradability and versatility, portable computers need not be viewed as disposable items.

• List price: *NEC UltraLite Versa 25C with 4MB RAM, 120MB hard disk, DOS 5.0, Windows 3.1, $4,269. NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-388-8000, 508-264-8000.*

Circle 431 on reader service card

Benchmark Tests: NEC UltraLite Versa 25C

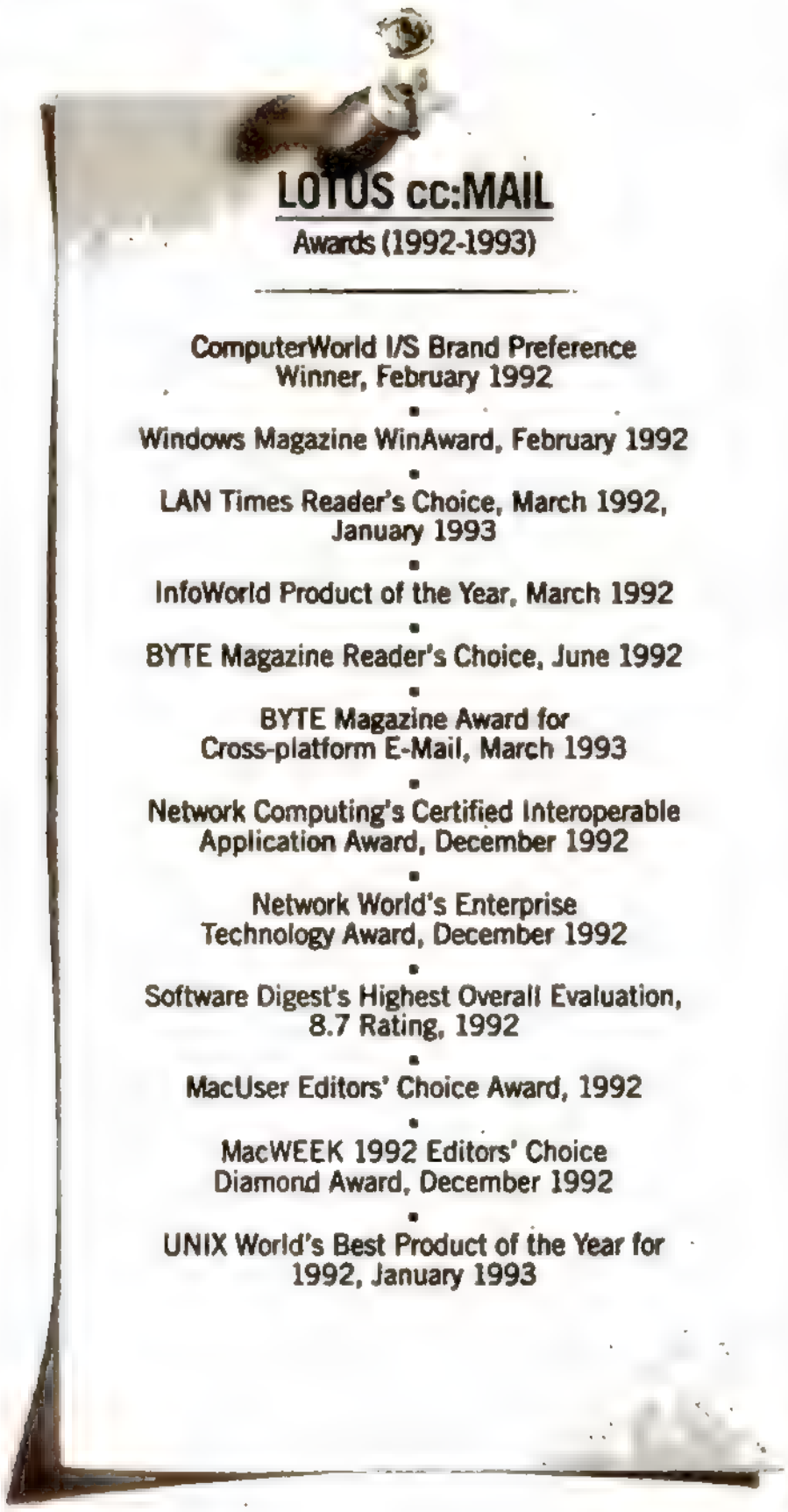
A graphics powerhouse, the 25-MHz, 486SL-based NEC UltraLite Versa 25C produced strong benchmark test results across the board. NEC has implemented local bus, controlled by the built-in Peripheral Interface (PI) in the 486SL processor. The Versa 25C's Graphics Winmark was more than double that of the Compaq LTE Lite 4/25C.

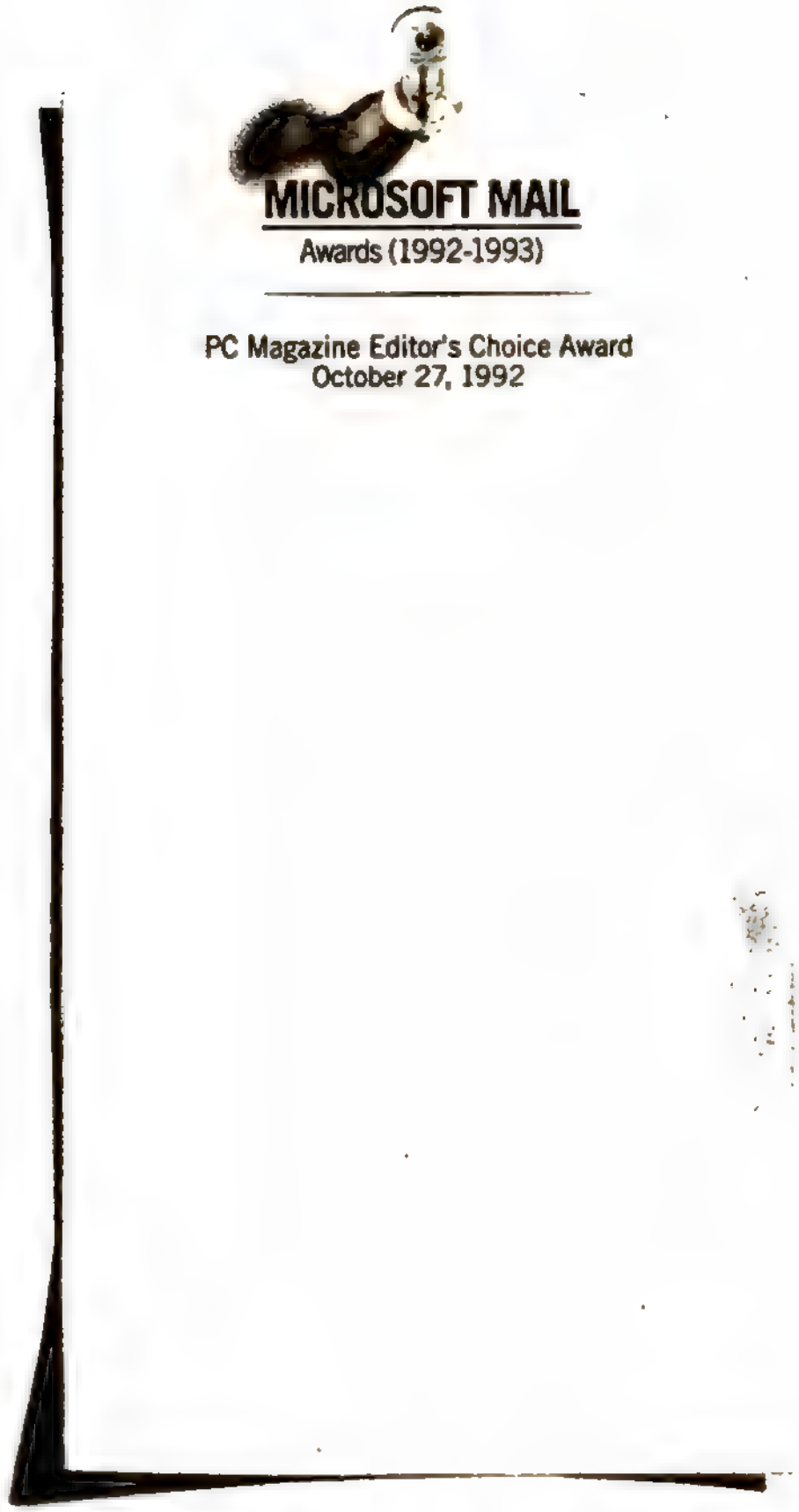
Without power management, battery life was average. With power management enabled and Microsoft's Advanced Power Management (APM) driver loaded, however, the Versa lasted 5 hours 2 minutes on PC Labs' ZDigit test.

We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.1, to measure each PC's processor, memory, video, and disk subsystem performance. The DOSmark is a composite rating derived from these four tests, and indicates a PC's ability to run DOS applications. The Graphics Winmark is based on 10 Microsoft Windows graphics and text functions, weighted to reflect how frequently the various functions are used.

We disable all power-conservation features for the Battery Rundown test, which provides a worst-case estimate of battery life. Likewise, we enable the system's power-management features for the ZDigit Rundown test, which simulates real-world usage.

Higher scores represent better performance	Processor (operations per second)	Memory (kilobytes per second)	Video (millions of operations per second)	Disk (kilobytes per second)	DOSmark	Graphics Winmark (megapixels per second)	Battery Rundown (Hours:minutes)	ZDigit (Hours:minutes)
NEC UltraLite Versa 25C	6,166	3,896	4.24	22.44	21.74	4.47	02:01	05:02
Compaq LTE Lite 4/25C	5,203	3,810	2.77	22.51	20.46	2.03	02:06	04:11
486SX/25 Average	5,483	3,985	2.27	19.26	18.90	2.42	02:23	03:48





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Utilities

LapLink V Adds Network File Transfer, File Syncing

BY ANGELA GUNN

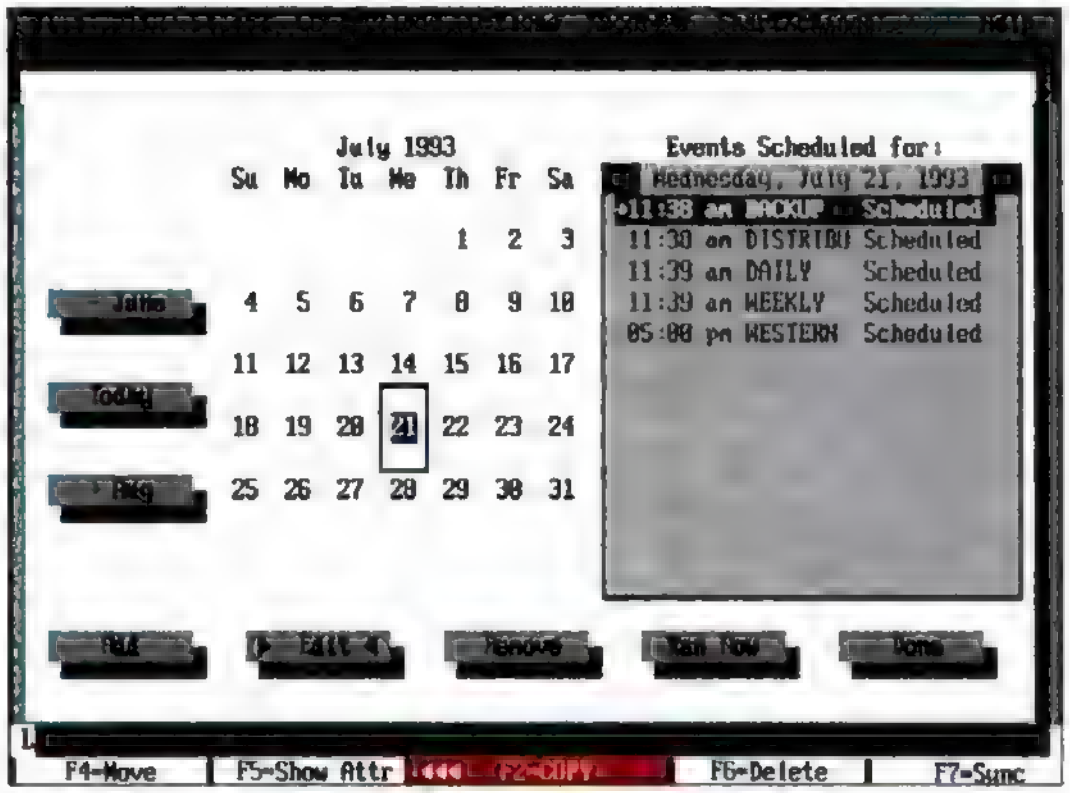
Can a utility be too sophisticated? The last revision of Traveling Software's venerable LapLink performed many of the modem-to-modem file-transfer functions of remote-control packages such as CO/Session and Norton pcAnywhere.

The newest version, LapLink V, works not only over serial, parallel, and modem cables, but even over the cables connecting your LAN, approaching the kinds of file-transfer capabilities that require a peer-to-peer LAN. But LapLink V users will need to ensure their networking driver software is up-to-date.

Sophistication certainly has its price, in terms of both money ($169.95) and memory. LapLink V requires a staggering 465K of RAM. The package has been optimized for Windows and can run as a background task, but you'll need to load it high. Additionally, we found its behavior under Windows to be rather poor.

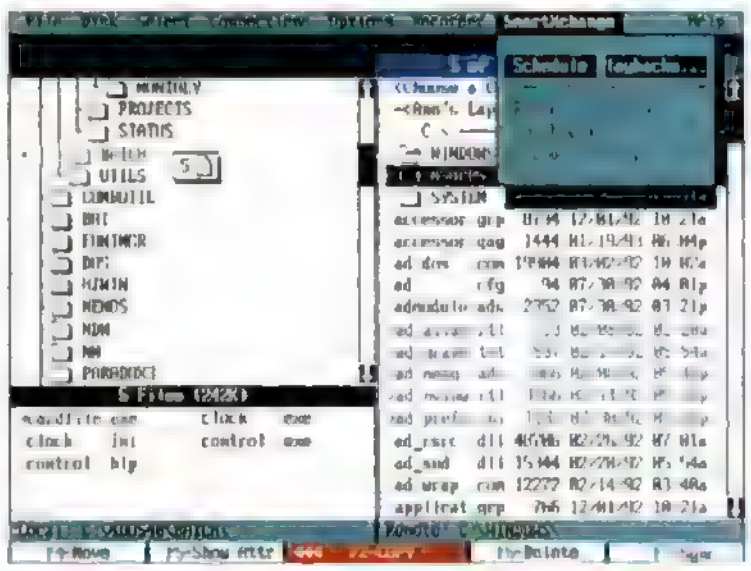
LapLink's file-transfer options are better than ever. You can now set up unattended scheduled file transfers with a suite of functions called SmartXchange. In addition to synchronizing files duplicated on two computers, SmartXchange lets you clone directories and perform quick file refreshes to keep everything in sync between machines. These actions can be recorded by the program for future duplication.

Recordings, in turn, can be scheduled to run unattended for up to a year in advance. This may sound dangerously similar to VCR programming, but the LapLink scheduling and transfer utilities have been intelligently set up and are extremely simple to use. The package even allows for automatic redialing.



IN ADVANCE: *LapLink V lets you schedule file operations.*

LapLink's interface has changed slightly but definitely for the better. The character-based interface now uses several graphical elements to represent files and directories. A mouse-accessible menu at the bottom of the screen displays the most-used commands, along with their function-key equivalents. Best of all, drag-and-drop support has been added. Otherwise the split-screen interface—easy to use if you remember the left-local, right-remote mnemonic—is essentially the same.



SMARTXCHANGE: *Record and play transfers.*

Some of the changes in LapLink V optimize the program for use under Windows and Windows for Workgroups, but if you plan to use LapLink V's NetWare file-transfer capabilities, you must be certain that you're running Version 3.26 or later of NETX.COM and Version 3.10 or later of IPX.COM (or, alternatively, version 1.20 or later of IPXODI.COM). Though this is important when operating under DOS, it's essential when running under Windows or Windows for Workgroups.

When we attempted to use the package under Windows with an earlier version of the network drivers, we experienced several baffling crashes. One of these crashes disabled our modem, and it remained disabled even after we rebooted and loaded Windows. Only by installing the later versions of the network drivers were we able to reestablish contact with the serial port.

LapLink V has several elements intended specifically for the Windows environment. The most important of these, a new communications driver, enables LapLink to go beyond the pathetically limited Windows 3.1 driver. The LapLink version of the driver ensures you can communicate at speeds above 38.4 kilobits per second.

Security is reasonably good: LapLink V offers password protection organized by machine, by user, and by directory. The package supports and adheres to NetWare's security structures. Use over the modem may be restricted to users previously entered in the phone book, and NetWare user names and passwords can also be kept there.

LapLink V is an indispensable utility for anyone who uses more than one computer, whether in the office or between the home and the workplace. NetWare users will find the new peer-to-peer file-transfer capabilities a welcome enhancement, though prior planning and driver updates are essential. Despite problems running under Windows, LapLink is still the essential file-transfer tool.

• List price: *LapLink V, $169.95.* Requires: *465K RAM, DOS 3.1 or later. Traveling Software Inc., 18702 North Creek Pkwy., Bothell, WA 98011; 800-343-8080, 206-483-8088; fax, 206-485-6786.*

Circle 423 on reader service card

FIRST LOOKS PLUS

To download a sample copy of the LapLink editor from PC MagNet, type GO ZNT:EXEC from any CompuServe prompt. From April 26 through April 30, you can go online to discuss LapLink V with *PC Magazine* editors and Traveling Software CEO Mark Eppley. Type GO ZNT:EXEC.

Gateway Just Went Platinum. . .

If Gateway 2000 was a record, what would we sound like? Music to your ears!

Those Old-Time Country Values – *by The Low Overheads*

Our album would kick off with some great Country tunes because, after all, we're the original country PC company with the low-overhead prices. We're located

in the heartland of America where our factory is bordered by corn and bean fields. KSUX country radio, the Super Pig, is the number one station in these parts (no fooling). Gateway folks are mostly midwest born and raised, and it shows in our quality workmanship and in the friendly, down-home way we treat our customers. We'll bend over backwards to please you. When you buy from Gateway, you get the best price, quality and service. That's a value nobody can beat.

Gimme the Good Stuff – *by Hammer and the Boys*

This song is dedicated to everybody who's tired of new technology becoming affordable only after it's upstaged by something better. At Gateway, we offer the latest, newfangled technology at homespun prices.

Baby, Let Me Baby You – *by The Support Group*

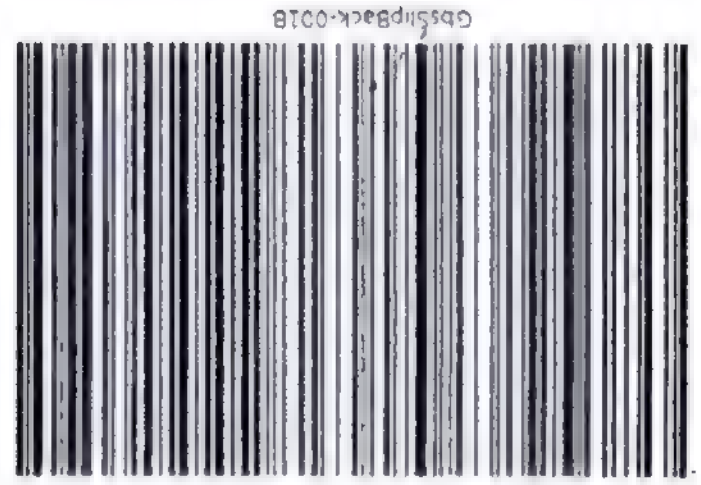
Every Gateway 2000 system comes with excellent after-the-sale support. You get a **30-day money-back guarantee**. If you don't like your system, send it back within 30 days for a refund. All systems come with a **one-year limited warranty** and telephone **technical support** for the life of the system from our award-winning tech department. We received *PC World's* World Class Award in 1992 for best service and support in the hardware category. And in a February 1993 survey, *PC Magazine* readers once again gave Gateway an excellent rating for service and reliability. You also get an **automated fax service** to supply you with detailed documentation on over 150 technical subjects, and a **lifetime BBS membership** for additional technical support and online forums.

We offer **on-site service** to most locations in the country (factory service only for notebooks). **Replacement parts** leave our factory as quickly as possible; we pay overnight shipping. Plus we now have **interactive documentation** on 486 desktop systems with pictures and text right on your hard drive (in addition to comprehensive hardware and software manuals).

We make it easy for you to buy a Gateway PC, too, with convenient payment options including major credit cards and C.O.D. terms. Net 30-day terms and leasing options are also available to qualified commercial customers. All this *and* your great-looking Gateway PC comes in our distinctive, country cow-spotted box!

To serve you better, we've hired and trained over 600 new people for customer service, technical support, sales and manufacturing in the past six months, bringing our total number of employees to over 2,000.

◀ *Gateway's 4SX-33 makes a mighty-fine Windows machine!*



Back

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Inverted Back

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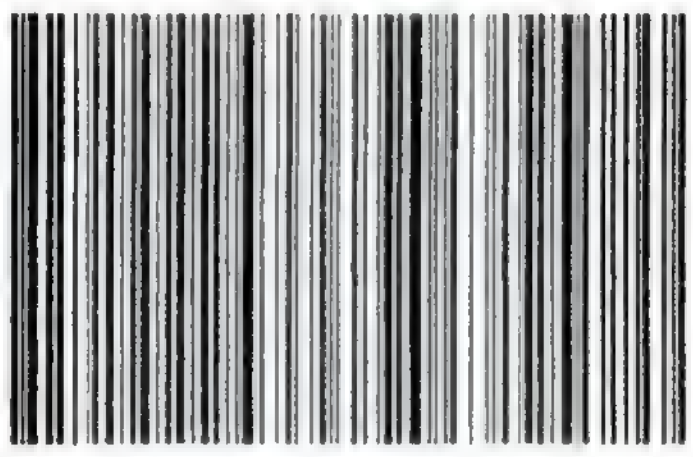

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Inverted Foldout slip-sheet

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2. Insert this sheet with
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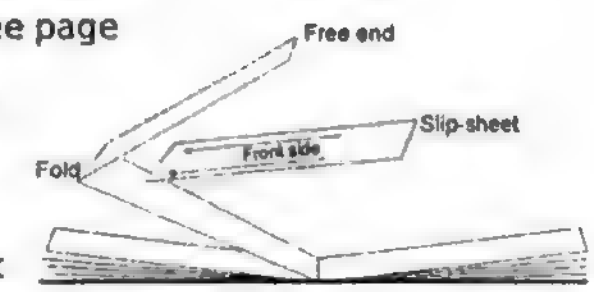
3. Slice the folded edge
4. Close the page and slip-sheet



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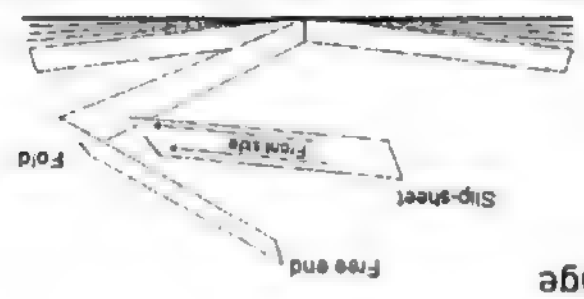

intel inside

Because We're Playing Your Song!

If Gateway 2000 was a record, we'd be receiving a platinum award – thanks to all of our wonderful customers. Our one-millionth computer system was shipped in April from our factory in North Sioux City, South Dakota. A million is a number that's hard to fathom. At least it is for us.

We send our deepest appreciation to each and every Gateway customer. Thank you for believing in us. We've tried hard to always offer you the best value in the personal computer industry. We've succeeded in meeting this goal, although we're the first to admit that demand for the value we offer has sometimes overwhelmed us. We thank you for the understanding and patience you've shown during our growth spurts.

We also want to thank our remarkable vendors – the companies that supply us with the highest-quality, most technically-advanced components, software and peripherals, and those that provide support services. Gateway 2000 has been a most demanding customer, and they deserve a lot of credit for our success.

Now our goal is to make the next million even better, one computer and one customer at a time!

Our award-winning 4DX2-66V system now includes a CD-ROM drive and a 3.5-inch diskette drive as standard features.

GATEWAY2000

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ROCK
R.E.M.
intel inside

We Got the Goods – *by The Systematics*

Gateway's album would continue with some heart-pounding rock 'n roll cuts because our systems are definitely pure rock. They're cool-looking, hot-performing, high-energy machines – at some sweet prices. There's a model that's perfect for you.

Megahertz So Good – *by Pup and the Cells*

Gateway's mini-desktop systems – 3SX-33, 4SX-33 and 4DX-33 – are petite but plenty powerful, based on an integrated design that incorporates many subsystems on the motherboard for the best price-performance ratio. All mini desktop systems include: 4 to 8MB RAM; a large and fast hard drive, operating on the local bus in 486 models for even faster drive performance; a fast video chipset with 1MB; a brilliant, crisp display from the standard 14-inch CrystalScan non-interlaced color monitor; and more available expansion slots than you find in most small-footprint PCs. The combination of these features makes a cool Windows machine for an unbeatable price.

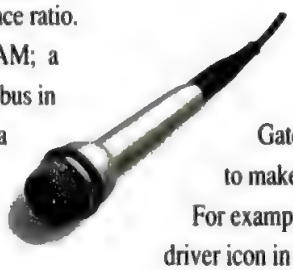
So You Wanta Fly? – *by The Screamin' Vs*

Power users, pick up the phone and order a Gateway 2000 VESA® local bus 486 machine right now. You'll never regret it. With our 4DX2-50V or 4DX2-66V models, you get screaming PC performance. We put ATI's Graphics Ultra Pro video card with 1MB VRAM on our VESA local bus for results that are simply awesome! Plus these systems have a hefty 8MB RAM with cache, and hard-rockin' hard drives running on the local bus. An extra VESA local bus expansion slot as well. You get a 15-inch flat, square CrystalScan color monitor and more choices of cool application software than you'll find anywhere else. Our award-winning 4DX2-66V now includes a CD-ROM drive, too!

We custom-build each Gateway 2000 computer to your order. We'll gladly provide you with a quote on a special configuration. Call our sales department!

Big Bandwidth Boogie – *by The Gates*

If you're looking for the 32-bit power of an EISA system, we offer three models – 4DX-33E, 4DX2-50E and 4DX2-66E. All models include: 8MB RAM with 256K cache; a very large, very fast SCSI hard drive; 32-bit EISA SCSI controller; and a standard tower case. Please call for details and prices on models not listed on our price page.



Workin' Up Some New Riffs – *by The Harmonics*

This one's our theme song. At Gateway, we're always looking for ways to make your PC easier and more fun to use. For example, we now install a Mach 32 video driver icon in your Windows control panel so you can change your video resolution quickly and easily.

All Gateway systems go through extensive compatibility testing to ensure flawless performance with all products from major software developers and peripherals manufacturers.

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◀ *According to PC World, "(Gateway 2000's 4DX2-66V is) by far the fastest machine we've ever tested!"*

GATEWAY 2000
all THAT
WORD
WINDOWS FOR WORKGROUPS
intel inside

Windows to the Other Side – *by Tommy Gee*

Gateway's album would also include jazz favorites because we offer a complete line of software and peripherals to make your system extra cool.

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◀ *Gateway's 4DX-33V is shown here with Windows Sound System components, the CD-ROM kit and optional speakers. Call for details on this system.*

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■ Multimedia

Play Any Sound or Video File with MultiMedia Works

BY MARK BROWNSTEIN

Lenel Systems' $99 MultiMedia Works, Version 1.0, isn't *the* killer multimedia app, but by providing players for a wide range of media types—MIDI and .WAV sound files, DVI, Microsoft Video for Windows, Apple Quicktime and Autodesk animations, .BMP graphics, standard text, and more—it does make the elements of multimedia more accessible.

In addition to multimedia video, animation, sound, still images, and documents, MultiMedia Works supports such analog devices as CD-ROMs or external VCRs, laserdisk players, and other video sources.

But MultiMedia Works goes beyond merely being able to play multimedia files. It can also be used to record some types of multimedia and control playback of specific frames or portions of a file from frame-accurate VCRs or from CD-ROM drives.

Most users will probably find MultiMedia Works most valuable as an easy-to-use multimedia player. Once loaded, all you have to do to play a file is select it in File Manager and drag it to the MultiMedia Works icon. Once it's dropped there, MultiMedia Works determines what type of file it is and activates the appropriate player.

If you aren't using File Manager now but have multimedia files you want to play without a fuss, you may find yourself keeping a File Manager window open on your system just to make it easy to play that sound clip or animation file you've been wanting to hear or see.

Fortunately, MultiMedia Works provides a hotkey that can automatically open File Manager, making it easier still to find and drag a file to MultiMedia Works.

FACT FILE

MultiMedia Works, Version 1.0

Lenel Systems International Inc., 19 Tobey Village Office Park, Pittsford, NY 14534; 716-248-9720; fax, 716-248-9185

List price: $99.

Requires: 4MB RAM, Microsoft Windows 3.1.

In short: MultiMedia Works plays just about any type of multimedia file with a simple drag-and-drop and lets you string them together into simple presentations.

419 ON READER SERVICE CARD

A Show feature lets you create rudimentary multimedia presentations. You open the Show Builder, move your multimedia files onto the Object List, and then copy files over to the Show List. From inside the Show List, you line up your objects in the order you want them to play.

MultiMedia Works defaults to opening a window when a sound or other object file is played, but it's easy to set Show to open an object in a window of a specific size and at any location. Controls for the window let you load other files or maximize or minimize the window. Sound files can play with the player window completely hidden.

You can set graphical objects to play with a musical background that you select. Graphics files can display for the length of the sound file or for a predetermined number of seconds. MultiMedia Works provides good flexibility for modifying the order in which each multimedia object will be played.

As a presentation product, MultiMedia Works is not as flexible or powerful as products such as Asymetrix's MediaBlitz are at scripting multimedia presentations. MultiMedia Works lacks sophisticated transition effects and doesn't offer the flexible control of multiple objects that presentation products do. It's also very slow at loading new objects. However, MultiMedia Works can still be used to create basic shows that contain true multimedia elements.

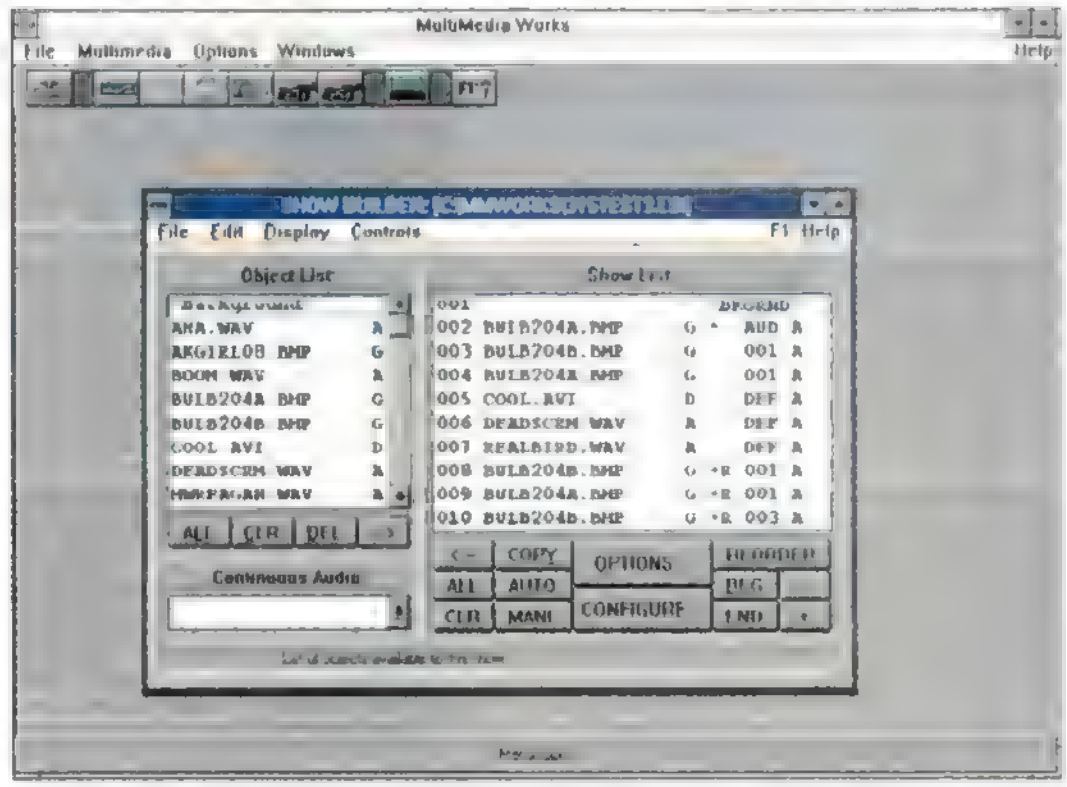
OLE SUPPORT

The feature in MultiMedia Works that may prove to be the most important is its OLE support. Objects, or even complete shows, can be copied into an OLE clipboard. From there you can open a document in an application that supports OLE (such as Excel or Word for Windows) and place a link object into the document (moving it from the Object clipboard into the actual document). When you double-click on the link object (an icon that appears in the document that looks like a graphic), it runs the slide show or displays (or plays) the object that is connected via the OLE link. If you don't have MultiMedia Works loaded when you go into a linked object, double-clicking the icon will launch MultiMedia Works and then load and run the linked objects.

Linking slide shows to documents may be fun today, but at some point in the not-too-distant future, you may be using a microphone attached to a sound card to attach comments to documents you work with. Attach a figure or two via the Show Builder, connect your dictated message to it, and link it to the original document, and you'll be able to send documents with complete multimedia annotations to others working on the same document.

One day soon it may be difficult to imagine how we ever got along without the ability to perform voice and graphical annotation on our work. The OLE capabilities and Show Builder in MultiMedia Works are a step in making this easier for the nonexpert user to do.

MultiMedia Works is not particularly easy to install and configure, but the ease with which it lets you access your multimedia files makes it an important product. In spite of the fact that most sound or video boards come with multimedia tools that often perform similar functions, MultiMedia Works is the common-denominator tool for every type of multimedia data. □



SHOW BUILDER: *Connect your multimedia files into a presentation.*

■ Workgroup Software

E-Quip: LAN Paper Management

BY STAN MIASTKOWSKI

The promise of workgroup productivity through centralized document management has been dangled in front of networked PC users for years. Too often, products promising to deliver that nirvana have been fraught with complexity and frustration.

Alacrity Systems' E-Quip addresses some of the problems, but it's complicated to install and many of its features are geared toward individuals rather than workgroups. And despite the company's claim that E-Quip will quickly pay for itself, the $2,995 list price for a five-user setup is only the beginning of the bucks you'll lay out to set up a capable system.

Think of E-Quip as office equipment for Windows. The whole point of the system is to use your printer and a full-page scanner (not included) as the basis for a setup that will handle document storage and retrieval, copying, and fax send/receive. The heart of the system is a full-size add-in board for the network server that's a send/receive fax server with its own processor, and a high-speed raster printer interface that pushes documents to your laser printer at incredible speeds.

SCANNER REQUIRED

To use E-Quip, you'll need a scanner and a proprietary $399 scanner interface (not included), a piggyback board that hooks directly into the E-Quip processor. (No, you can't use your existing scanner interface.) Installing the whole thing in the PC that becomes the E-Quip server isn't easy. The E-Quip board isn't unique in using both I/O ports and upper memory address space, but finding an open combination that works is seldom a piece of cake.

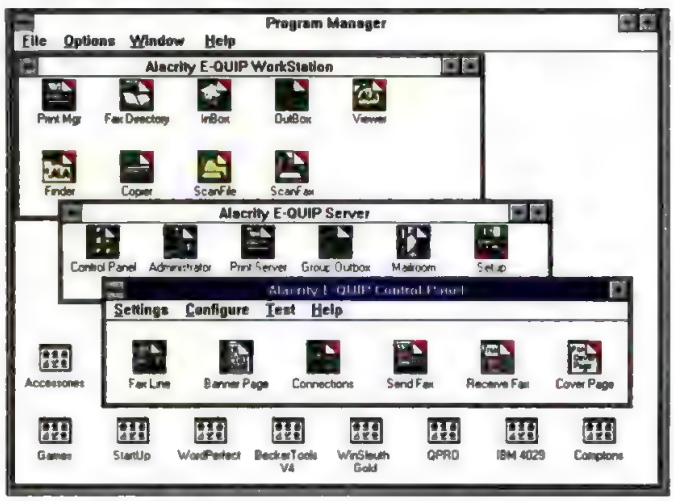
E-Quip works with any NetBIOS-based network, such as NetWare or LANtastic. We tested it on a five-station network running Microsoft Windows for Workgroups. Server software is installed first on the PC that has the E-Quip board, where extensive changes are made to your Windows .INI files. You set up accounts and then install workstation software on both the server and the connected workstations. It's time consuming, and on our test network it required quite a bit of tweaking before it would work correctly.

It's quickly obvious that the basic system offers the person at the server most of the goodies. The printer/scanner combination offers copying, printing, and plain-paper faxing. Workstation users without extra hardware get access to the fax server for outgoing faxes, using a driver that lets them fax directly from their Windows application. For incoming faxes, it's a matter of walking over to the central printer or counting on the person at the E-Quip server to send the fax via electronic mail.

In order for workgroup members to get some utility and the promised productivity out of E-Quip, virtually everyone needs a scanner and (preferably) a printer as well. (Of course, there's no high-speed interface for a workstation-connected printer.) Adding these peripherals can run into major money, not to mention that it sweeps away one of the main money-saving advantages of a network. Scanner prices have come down, but the Microtek and Hewlett-Packard scanners that E-Quip supports still go for street prices in the $800 to $900 range. Then you have to add the $800 or more that capable laser printers cost.

The main reason everyone really needs a scanner is E-Quip's document imaging and management features. Scanned documents, received faxes, and existing data files are all organized by the Alacrity Finder. You can enter document descriptions up to 128 characters long, and can later search for key words or phrases. The Finder works well, but it requires commitment and discipline. Get behind a few days and you might as well forget the whole thing.

E-Quip's document-management abilities are extended even further by an OCR (optical character recognition) package that turns scanned documents into computer-readable form. Unfortunately, that too is optional ($79 per workstation).



DESKTOP ASSISTANT: *E-Quip eases time-consuming office chores.*

SINGLE USER SOLUTION?

If you're lucky enough to have a computer equipped with both a scanner and a printer, E-Quip eliminates scads of trips to the copier, fax machine, and departmental printer. But the requirement of relying on the server user to send you your faxes adds an inconvenient hitch to the process.

It's difficult to understand why Alacrity doesn't offer a single-user version of E-Quip, because it's a system that offers individuals a well-designed and comprehensive way to tame the typical paper avalanche. But when you add all the options you really need to take full advantage of it, E-Quip's bottom line becomes intimidating. □

FACT FILE

E-Quip
Alacrity Systems Inc., 43 Newburg Rd., Hackettstown, NJ 07840; 908-813-2400; fax, 908-813-2490

List price: Five-station kit, $2,995; additional five-user licenses, $995; scanner interface, $399; OCR, $79 per workstation.

Requires: Server: 4MB RAM; 10MB hard disk space; NetBIOS-compatible network operating system; Microsoft Windows 3.1; Hewlett-Packard LaserJet II or III, IBM 4019 or 4029, or Canon LBP8 Mark II+ printer; Microtek MSII, MSF 600G, or Hewlett-Packard ScanJet scanner. Workstation: 4MB RAM, 14MB hard disk space, Microsoft Windows 3.1.

In short: A hardware add-in card and Windows software that consolidates fax, printing, scanning, copying, and document management. The price is high, and although only available for networks, its abilities are more suited to individual users.

410 ON READER SERVICE CARD

Network Printing

NETPrint/100 Replaces PC As Dedicated Print Server

BY CRAIG ELLISON

If you're planning to add a network printer to your NetWare network and don't want to dedicate a PC as a print server, Digital Product's NETPrint/100 could be your solution. The $995 Token Ring version supports transmission rates of 4 or 16 megabits per second, has a DB-9 connection for shielded twisted-pair cabling, and has an RJ-45 port for unshielded twisted-pair wiring. The $695 Ethernet version supports thin net or a 10BaseT connection.

NETPrint/100 is a small dedicated print server that connects directly to your network cabling. It eliminates the need for a PC to be dedicated as a print server as well as the need to run Novell's PSERVER NLM or VAP. It connects to your printer either through its parallel port or its uniport. The uniport can be used for serial printers at up to 19,200 bits per second or, with the $80 Uniport-out option, for a remote parallel printer at up to 115 kilobits per second.

Installation couldn't be easier. Although the product has an install program, you can install it with Novell's PCONSOLE utility. If it doesn't log on to your network, an error report detailing the problem and solutions will print.

Network administrators will appreciate its ability to reattach and log on to a file server automatically. This eliminates the need to reboot the print server after a file server has been reinitialized.

BIG JOBS: *Diminutive print server.*

NETPrint/100 has a high-performance parallel port. In testing on a 33-MHz 486, the unit printed 5 1.5MB queued PostScript print jobs to an attached HP LaserJet 4Si 32 percent faster than Novell's PSERVER printing to the same printer. For 10 800K uncompressed PCL print jobs, NETPrint/100 was 29 percent faster. When printing 20 150K PCL 5 print jobs, NETPrint/100 outperformed PSERVER by only 4 percent.

NETPrint/100 is an easy-to-install, robust solution to network printing. If you want to set up remote printers on your LAN and don't want to dedicate a PC, this is the way to do it.

• List price: *NETPrint/100, Token Ring version, $995; Ethernet version, $695.* Requires: *NetWare 2.x, 3.x, or 4.0. Digital Products Inc., 411 Waverly Oaks Rd., Waltham, MA 02154; 800-243-2333, 617-647-1234.*

Circle 427 on reader service card

Fax Software

DataFax Lets You Forward Faxes, Hang Up on Junk

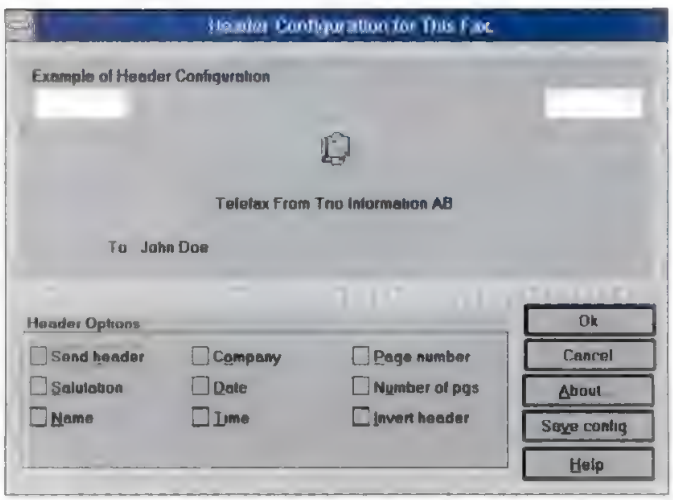
BY EARLE ROBINSON

New and improved fax modems are inspiring more-reliable, more-usable fax software. Trio Information Systems' DataFax for Windows 4.0 ($129 with optical character recognition, $79 without), one of the latest entries, has some unique offerings.

Most interesting is its ability to forward incoming faxes to another number, a sort of "call forwarding" for faxes. You can also prepare a list of phone numbers that will be acknowledged when they send a fax, though the fax will never actually be received, a convenient way to dump junk faxes.

Like Delrina's WinFax Pro 3.0, DataFax keeps up with you wherever you travel. Changing the home area code to the one where you're currently located permits faxing from anywhere. There are also 20 foreign-language headers for cover sheets. Sending a fax to Germany? You choose German language headers, which insert the country code for dialing, too.

DataFax offers support for different dialing directories and the ability to define them as required, by country or any other criteria. The international flavor is continued with the choice of country codes for entries, too. Indexing can be used to keep track of both inbound and outbound faxes. There are four log files kept: pending, received, transmitted, and unsent due to errors. Macros for automating links with Windows word processors and Microsoft Excel through DDE are provided.



COVER UP: *DataFax has 20 foreign language headers for cover sheets.*

DataFax's OCR engine is the best we've seen. Compared with the Caere engine in WinFax Pro 3.0, DataFax's Expervision engine made fewer errors—though, as with other implementations, italics and several lowercase letters were poorly recognized. DataFax supports scanning from Twain-compliant scanners. A search-and-find program with hypertext is also provided.

There's a network version of DataFax ($595 for 5 users) that makes the ability to "call forward" faxes even more valuable. The minimal configuration, without OCR, uses 3MB of memory—much more than the economical Eclipse Fax, which uses less than 1MB. The OCR functions add another 5MB.

Though not without weaknesses (such as confusing installation and no labeling of buttons and icons), DataFax makes quick work of faxing. It's well worth consideration, both for the individual user or for network installation.

• List price: *DataFax for Windows, Version 4.0, $129.* Requires: *3MB RAM, 3MB hard disk space, Microsoft Windows 3.0 or later. Trio Information Systems Inc., 8601 Six Forks Rd., #615, Raleigh, NC 27615; 919-846-4990; fax, 919-846-4997.*

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▲ *dBASE meets a much wider range of needs than FoxPro.*

*The results of the Product Comparative Usability Testing—DOS Database Software, dated September 1992. †*Software Digest* Rating Report, multiuser database programs, May 1992. Copyright © 1993 Borland International, Inc. All rights reserved. All Borland product names are trademarks of Borland International, Inc. Prices good in the United States and Canada only. All prices are in U.S. dollars. Dealer prices may vary. BI 4384

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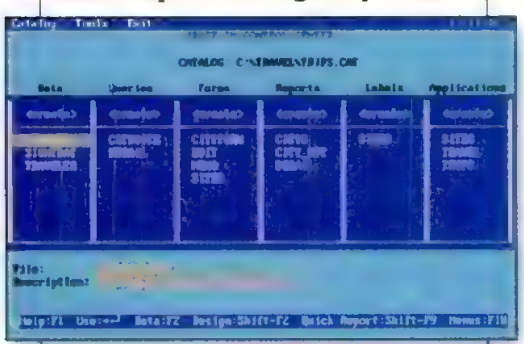
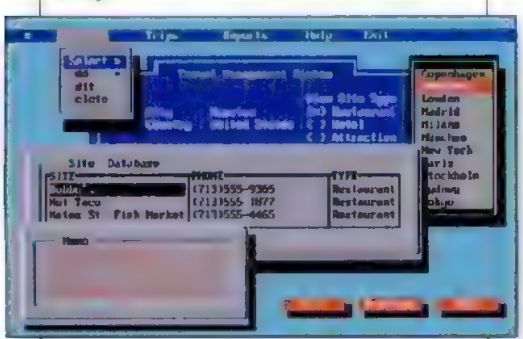
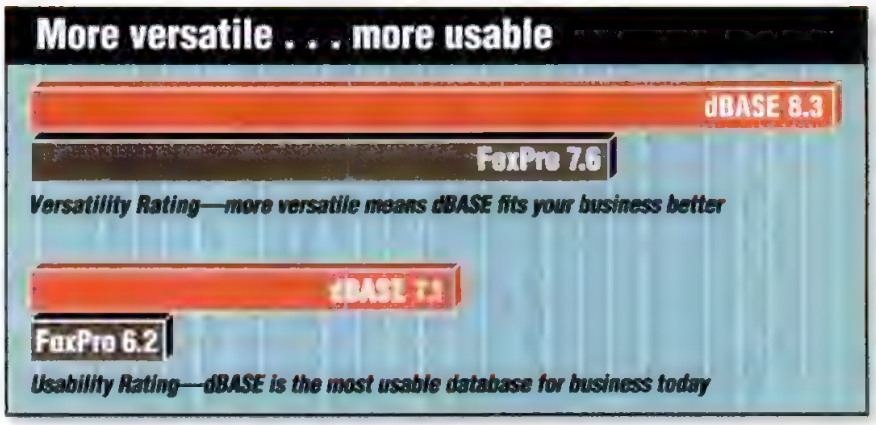


▲ *From the dBASE Control Center, your data is only a mouse click or a keystroke away.*



▲ *Build sophisticated applications in record time.*



▲ *NSTL found dBASE to be the favorite of both novice and experienced users alike in Overall Usability and Versatility.*

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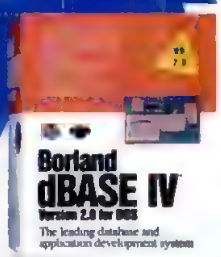

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Fax Software

FaxWorks Brings Faxing to OS/2 Apps

BY EDWARD MENDELSON

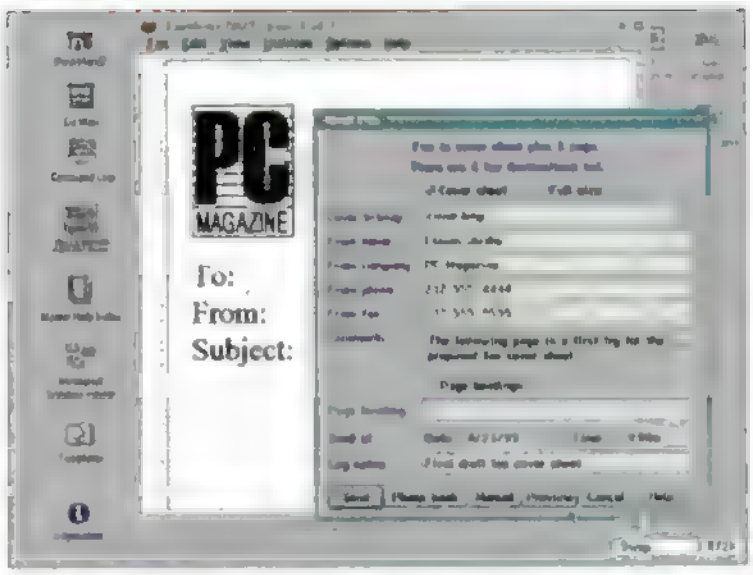
FaxWorks OS/2 converts OS/2 into a full-featured environment for sending and receiving faxes with virtually any fax modem, and it's the one product that lets Intel's SatisFAXtion products work as well under OS/2 as they do under DOS and Windows.

SofNet's $129 package lets you fax as easily as you print from any OS/2 application or from any Windows or DOS application running under OS/2. If you don't want to open another application just to send a fax, the program includes a miniature text and graphics editor that lets you create a quick fax complete with graphics.

FaxWorks' editor lets you view incoming faxes and annotate them with text, drawing tools, or imported graphics; then you can print the modified fax, save it as a graphic file, or transmit it again as a fax. You can import .BMP, .PCX, and TIFF files and import text files or enter text directly using any font supported by OS/2. Any element in the fax can be repositioned or erased with the mouse, and the same drawing and text tools let you create faxes from scratch.

Like most fax software, the program consists of two parts: the editor program and a fax driver that appears on the list of printer drivers available from the print menu of OS/2 applications. FaxWorks can send faxes from Windows and DOS applications running under OS/2 if you install the standard IBM ProPrinter driver and assign it to LPT3. The FaxWorks driver automatically intercepts the output, pops up a menu asking you for a destination, and transmits it as a fax.

In its latest version, 1.28, FaxWorks OS/2 makes it possible to perform a "fax merge" that is comparable to a print merge. You need an OS/2, Windows, or DOS application whose macro programming language lets you output the phone number field from the merge file to a file on disk, so the process isn't fully automated, but the macro programming involved is relatively simple.



FAX READY: *FaxWorks lets you add comments to the log when you send a fax.*

If you want to send faxes from OS/2, FaxWorks may be your only choice at this time. IBM will include a fax applet in OS/2 Version 2.1, but it will work only with Class 2 fax modems, which are still somewhat uncommon.

- List price: *FaxWorks OS/2, Version 1.28, $129; ten-user LAN version, $699; unlimited users, $1,799.* Requires: *6MB RAM, OS/2 1.3 or later, Intel, SendFax, Class 1 or Class 2 fax modem. SofNet Inc., 380 Interstate North Pkwy., #150, Atlanta, GA 30339, 800-432-9967; 404-984-8088; fax, 404-984-9956.*

Circle 417 on reader service card

Fonts

infiniType Plus Prints 124 Fonts, Has Special Effects

BY EDWARD MENDELSON

SoftMaker's $99 infiniType Plus contains 124 high-quality fonts in both PostScript and TrueType format, together with software that lets you use the PostScript fonts with DOS word processors and non-PostScript printers. No other font package combines so much quality and quantity at such a low price.

The package's TrueType fonts work under Windows. The PostScript Type 1 fonts work with any PostScript printer and any DOS or Windows application that supports PostScript, including Adobe Type Manager.

If you have a LaserJet or dot matrix printer, you can use the PostScript fonts with the DOS versions of WordPerfect, LetterPerfect, Microsoft Word, or Microsoft Works by loading the package's memory-resident font-processing software before you run the word processor. This software generates fonts in your computer and downloads them to the printer. The fonts include a variety of standard text faces and headline designs, plus fonts for symbols.

The DOS software in the package lets you apply special effects such as shadows and patterns to any font, using awkward codes that you add to your documents. Most font special effects are too clumsy to bother with, but infiniType's effects print with surprising clarity.

infiniType's main competition in the DOS font software market is LaserTools' $99.95 PrimeType, which comes with 20 of Adobe's best faces in PostScript Type 1 format only.

SAMPLE: *Some of infiniType's special effects.*

PrimeType runs marginally faster than infiniType (5 seconds faster on a 10-page document that takes infiniType 90 seconds). It also uses only 17K RAM instead of infiniType's 33K, and returns keyboard control to you faster.

PrimeType also gives you more flexibility when you install fonts that don't come in the package. It intelligently installs the special symbols in Adobe and Monotype "expert set" fonts, so you can access them using WordPerfect's standard symbol codes. infiniType simply dumps everything in the expert-set fonts into WordPerfect's "user-defined" character set, which means you'll have to figure out for yourself which number matches the symbol you want to print.

For basic text printing and special effects, infiniType Plus offers unbeatable value. For high-quality typography using expert set fonts, and for the widest range of font support, PrimeType remains unchallenged.

- List price: *infiniType Plus, Version 1.0, $99.* Requires: *640K RAM, 4.5MB hard disk space, WordPerfect for DOS, LetterPerfect, Microsoft Word for DOS, Microsoft Works for DOS, or Windows 3.1 or later. SoftMaker Inc., 2195 Faraday Ave., Suite A, Carlsbad, CA 92008; 800-346-5764, 619-929-6030; fax, 619-929-6034.*

Circle 418 on reader service card

Graphics Software

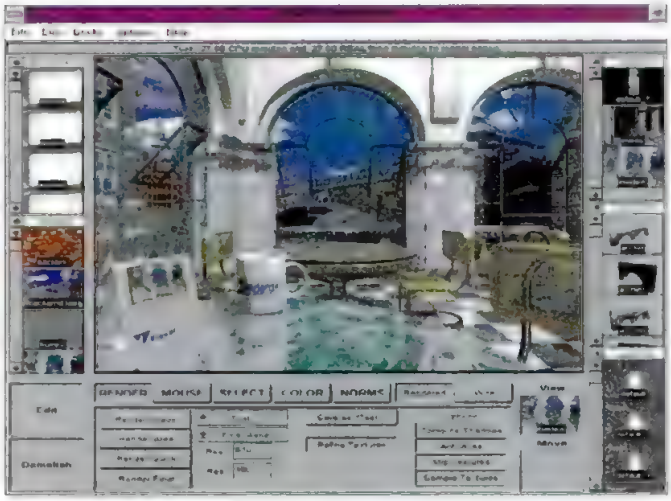
$895 Renderize Solidifies 3-D Wireframes

BY JAMES KARNEY

If working with 2-D graphics leaves you flat, try Renderize for Windows, Version 2.0, from Visual Software. This $895 program lets you manipulate and render 3-D images and then export the results to popular drawing and painting programs. It's aimed at two groups of users: professionals, such as engineers and architects who are already working with 3-D CAD graphics, and illustrators currently limited to 2-D in Windows.

Renderize starts with wireframe objects imported from AutoCAD .DXF or waveform .OBJ files. You have almost total control of the virtual 3-D world, including lighting, surface material, fills, shading, color, texture, and angle of view.

Let's say you want to render an image of a dining room. You can give the table a wood finish with a polished sheen and the crystal a soft glow that has sparkling highlights. Changing the background to look like fancy wallpaper is easy, too. Included with Renderize are two CD-ROMs containing a wide variety of 3-D clip art and images for use as fills and textures.



REAL OR RENDERIZED?: *Apply lighting, textures, and shading.*

A master window, called the Viewport, provides WYSIWYG views of your work as well as access to controls. Some controls are very intuitive, but others require practice. You can export drawings in .BMP, EPS, .GIF, native .RAW, SUN Raster, .TGA, and TIFF formats.

Renderize demands heavy-duty hardware. It's a full-blown 32-bit app that pushes Windows and DOS to their limits. While the program will run on a 386 with a coprocessor, it really needs a 486 with a hard disk and display adapter to match.

A stripped-down Renderize for Windows Light sells for $495. It limits output to 1,024-by-768 resolution with a 4:3 aspect ratio (for 35-mm slides) and doesn't support enhanced scanning and printer drivers.

While 3-D graphics isn't for everyone, Renderize can put some depth in your work without a lot of hassle.

• List price: *Renderize for Windows, Version 2.0, $895; Renderize for Windows Light, $495.* Requires: *16MB RAM, 25MB hard disk space, math coprocessor (486-based system recommended), 800-by-600 color display, Windows 3.1. Visual Software Inc., 21731 Ventura Blvd., #310, Woodland Hills, CA 91364; 800-669-7318, 818-883-7900; fax, 818-593-3750.*

Circle 420 on reader service card

Portable PCs

Aquiline's 66-MHz Notebook: Too Hot to Handle?

BY TIN ALBANO

The Aquiline NT466C, the first 66-MHz 486DX2-based laptop to arrive at PC Magazine Labs, offers a glimpse of future portable processing power but leaves much to be desired.

Aquiline packs the NT466C with an 8-millisecond, 540MB Seagate hard disk, 16MB RAM, and an active-matrix color screen. While this display of PC muscle is intriguing, the NT466C is just too big, too hot, and too battery-draining to be a sensible buy.

Our test system, which was equipped with a 120MB Conner hard disk and 16MB RAM, sells for $4,790. A base model with 4MB RAM sells for $4,195, and a model with 16MB RAM and a 540MB hard disk costs $6,290. The NT466C requires so much juice to run all those components that its road life is limited to about an hour and a half, according to ZD Labs' ZDigit test. Notebooks powered by Intel's 50-MHz 486DX2 processor averaged 3 hours 11 minutes.

Nor is the NT466C's performance much better than the 50-MHz 486DX2s we've tested. Though its Processor benchmark test result (9,718) is marginally higher than the average of 50-MHz 486DX2 notebooks tested by PC Labs, that number is significantly lower than that of the average 66-MHz desktop unit, because the NT466C lacks a second-level cache.

Most notebook users will find the 6.7-pound NT466C ungainly because of an external battery pack that weighs an additional 2.2 pounds and attaches awkwardly to the back. With its 1.5-pound power brick, the NT466C weighs 10.4 pounds.

Another problem in equipping a laptop with a 66-MHz clock-doubled chip is cooling the processor. Though desktop systems have room for elaborate cooling systems, portables don't. Aquiline tries with a high-speed fan that attaches to the CPU and blows the heat through a vent beneath the screen. The result is noisy whirring and hot air on your fingers.

COOLING OFF: *66 MHz has its price.*

Users who need high CPU performance and who won't put up with larger luggable PCs may find the NT466C appealing, but the system's short battery life limits its usefulness.

• List price: *Aquiline NT466C, with 4MB RAM, 120MB hard disk, $4,195; with 240MB hard disk, $4,495; with 540MB hard disk $5,695; 16MB RAM upgrade, $595; docking station, $295. Aquiline Inc., 283 Old Loudon Rd., Latham, NY 12110; 518-785-6517; fax, 518-785-0283.*

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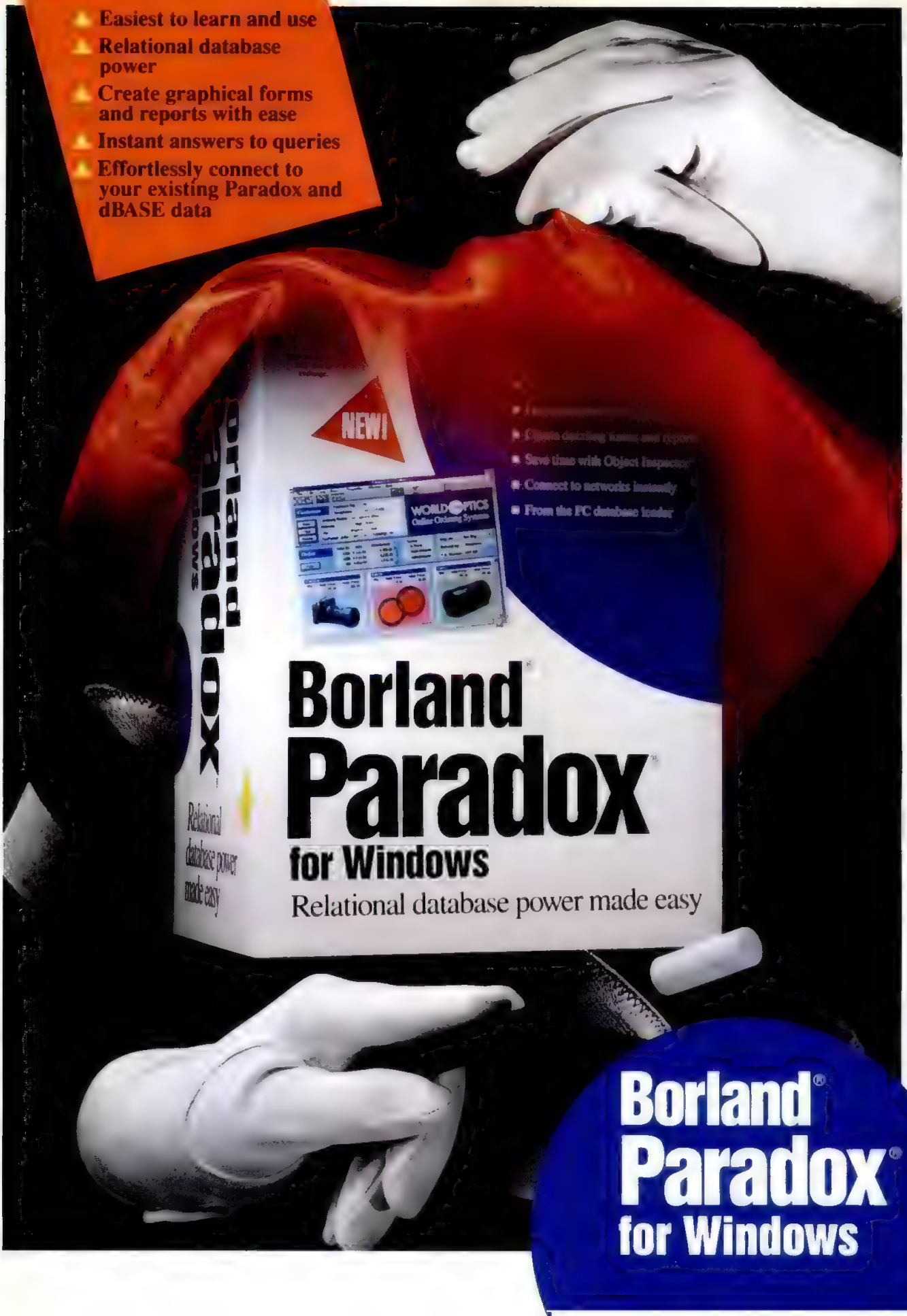

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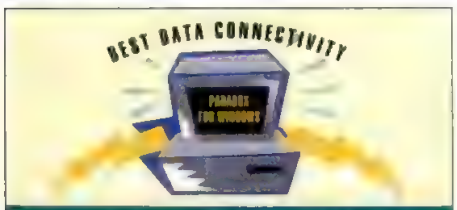

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P3 will be used to rebuild the Autobahn in what was formerly East Germany. Both contractors and subcontractors are standardizing on Primavera for this project.

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This $20 billion airport construction project also includes the construction of highways, an airport rail system, a suspension bridge and a cable stay bridge. Projected completion is June 1997.

Kuala Lumpur Tower, Malaysia

This $100 million, 420-meter tower will be the third tallest communication tower in the world. Estimated completion date is 1996.

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CIRCLE 148 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

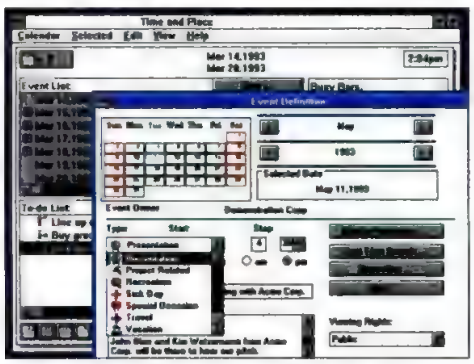
NEW

IBM's Group Scheduler Supports OS/2 and Windows Clients

IBM is taking its own steps to produce applications for OS/2 by shipping Time and Place/2, a LAN-based group scheduler that will fit into their LAN office solution along with Lotus Development Corp.'s Lotus Notes and cc:Mail. Time and Place/2 lets you control events, to-do lists, memos, and meeting schedules across a single or multiple LAN environment. A generalized time manager lets you manage numerous corporate resources, from people and conference rooms to equipment.

Time and Place/2 supports both OS/2 32-bit and Microsoft Windows 3.1 clients and will operate with NetBIOS from either OS/2 LAN or NetWare servers. It supports the Vendor Independent Messaging (VIM) interface for communicating with a variety of mail systems.

OS/2 clients will benefit from Time and Place/2's exploitation of the OS/2 Workplace Shell and its drag-and-drop functionality. Secretaries, for example, can create multiple calendars on the OS/2 desktop to support more than one person. Time and Place/2's server is an OS/2 32-bit application that uses the IBM Extended Services Database Manager, and it will support Database 2 OS/2 Version 1 when it is available.



Time and Place/2 also offers a Windows client from which you can schedule group meetings.

•List price: *Time and Place/2, $595 per server, $55 per client; IBM Corp., LAN Office Marketing, MD40-E2-03, One East Kirkwood Blvd., Roanoke, TX 76299; 800-426-2255, Dept. S-41; fax 404-238-3442.*
Circle 404 on reader service card

HOT PROSPECT

NeXT Enters the 32-Bit Operating System Fray

Having relinquished its hardware business, NeXT is planning to stage its own siege of the 32-bit operating system throne. It has ported its NeXTStep operating system to the Intel architecture, inundating it with features and remaining up front about the hardware requirements for running such a powerful operating system: a 486-based system with 12MB of RAM and 120MB hard disk space.

The steep requirements make sense when you consider what's included in the new NeXTStep. Among other advanced features are Display PostScript Level II, a multimedia e-mail system, full indexing and retrieval capabilities, and support for professional colors using Pantone color palettes. NeXTStep ships with runtime versions of several kits for taking advantage of the completely object-oriented system to create custom applications easily.

The NeXTStep system itself includes the Workspace Manager for managing network-wide documents and applications, object links for sharing data across programs, DOS and Windows support applications as well as support for all NeXTStep computers, and NetWare client software for access to Novell servers.

• List price: *NeXTStep for Intel Processors, $995. NeXT Inc., 900 Chesapeake Dr., Redwood City, CA 94063; 800-879-6398, 415-366-0900; fax, 415-780-3714.*
Circle 401 on reader service card

IMPROVED

Compaq Assaults Market Again: New ProLineas, Conturas

Compaq Computer Corp.'s Intel 486-based line of ProLineas now features proprietary local-bus video based on the Tseng ET4000 graphics processor. New ProLineas include a 66-MHz 486DX2-based model and Compaq's first multimedia system, the ProLinea CDS, which has a 25-MHz 486SX processor, internal CD-ROM drive, sound board, and external speakers.

Compaq has also announced three new Conturas based on 25-MHz 486SL processors. Each has a built-in trackball and a hard disk that can be upgraded to 209MB. The Contura 4/25 has a 9.5-inch passive monochrome display; the 4/25c has a 9.5-inch passive color display that makes two simultaneous sweeps to offer twice the clarity; and the 4/25CX has an 8.4-inch active-matrix display.

•List price: *ProLinea 4/25s, 4/33, 4/50, and 4/66, $1,099 to $1,999; ProLinea CDS, $1,699; Contura 4/25, 4/25c, and 4/25CX, $1,999 to $3,299. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670; fax, 713-378-1443.*
Circle 402 on reader service card

NEW

PostScript Goes Portable

PostScript-compatible printers are coming down in price, and **Mannesmann Tally** is going one step further by making PostScript printing portable. The new MobileWriterPS, with its PostScript language interpreter and 35 PostScript-compatible fonts, weighs just 8.3 pounds and measures 2.3 by 11.4 by 8.7 inches (HWD). It's based on a 6-page-per-minute thermal transfer engine that gives you near-laser quality output at 300 dots per inch. The printer's nickel cadmium battery is built into the unit and delivers 150 pages per charge. If you don't require PostScript, the less-expensive MobileWriter is HP PCL4-compatible.

•List price: *MobileWriterPS, $999; MobileWriter, $875. Mannesmann Tally Corp., P.O. Box 97018, Kent, WA 98064-9718; 800-843-1347, 206-251-5524; fax, 206-251-5520.*
Circle 403 on reader service card

Photography by Thom O'Connor

IMPROVED

Microcom Ships Version 2.0 Of Carbon Copy for Windows

Microcom has made many important enhancements to the second version of its remote-control package, Carbon Copy for Windows. Among the most significant are the incorporation of LAN support for remotely accessing data and applications across a NetWare LAN, and asynchronous communication server support for dialing remote PCs from a LAN. Carbon Copy for Windows now supports 256-color Super VGA cards, and a new feature called Virtual Desktop lets the user of a guest PC view the entire screen of the host PC if the latter's resolution is higher.

Other new features include a Remote Clipboard for cutting and pasting data from a remote application; Roving Callback, which lets you specify the phone number from which you're calling when you use the callback feature; and an Event Log that records information about remotely controlled events. Carbon Copy for Windows 2.0 also provides full-screen DOS support as well as full compatibility with Carbon Copy for DOS.

•List price: *Carbon Copy for Windows, Version 2.0, $199. Microcom Inc., 500 River Ridge Dr., Norwood, MA 02062-5028; 800-822-8224, 617-551-1000; fax, 617-551-1968.*
Circle 405 on reader service card

NEW

With VideoLabs' FlexCam Your PC Can Look at *You*

PC peripherals are moving closer to the gadgets you've seen in science fiction movies. Just look at the FlexCam desktop camera from **VideoLabs**. It consists of a tiny high-resolution color camera and two microphones mounted at the end of an 18-inch flexible gooseneck stand, providing a plug-and-play method for using video and voice to communicate from your desktop PC. The FlexCam is compatible with all popular video digitizing boards and can be used for audio and video input to VCRs, videoconferencing systems, and any other device that accepts NTSC or PAL video.

FlexCam looks like a sci-fi gadget, but it's actually a desktop video camera.

•List price: *FlexCam, $595. VideoLabs Inc., 5270 W. 84th. St., Minneapolis, MN 55437; 612-897-1995; fax, 612-897-3597.*
Circle 406 on reader service card

BRIEFS

SYSTEMS AND MONITORS

When **Compaq Computer Corp.** announced its new Conturas and ProLineas, it also announced enhancements to its Deskpro/M and Deskpro/i lines. The Deskpro/M is now available in a Windows edition with 8MB of RAM at no extra charge. New to the Deskpro/i line is a network-ready system that uses an Intel EtherExpress Ethernet daughter card. Both lines now come in models featuring 340MB hard disks. 800-345-1518, 713-370-0670; fax, 713-378-1443.

Dell Computer Corp. has added the ValueStation 386 ($1,499) and the ValueStation 486 ($1,999) to its line of multimedia systems. Both include a sound card, CD-ROM drive, speakers, and CD-ROM software. The ValueStation 486 also comes with a 2,400-bps modem and a one-month membership to the Prodigy on-line service. (If you don't want the communications package, knock $39 off the price.) 800-289-3355, 512-338-4400; fax, 800-727-8320.

AST Research has introduced its new Premmia family of PCs ($2,095 to $4,195) with a lineup of features including local-bus video with an ATI mach32 chip set, Pentium upgradability by way of an optional processor card, and a choice of Intel 486-based processors ranging from a 33-MHz 486SX to a 66-MHz 486DX2. Also in the new line are an advanced wall-and-lock security system, AST FlashBIOS, and a module for intergrating Ethernet on the motherboard. 800-876-4278, 714-727-4141; fax, 714-727-9355.

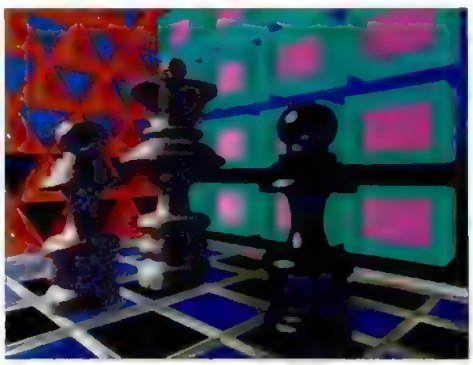
Tri-Star Computer Corp. is offering a second generation of its VL-Station VESA local-bus systems ($2,000 to $3,500) with optional removable hard disks and a new VL-Bus IDE cache controller with 2MB of RAM. Intel processors available include the 33-MHz 486DX, the 50-MHz 486DX2, and the 66-MHz 486DX2. 602-961-3401; fax, 602-961-4010.

Wang Laboratories is back in the game with a new line of Intel 486-based

NEW

StrataVision Comes to the PC

Yet another high-quality graphics program has made its way from the Macintosh to the PC. Now you can use **Strata**'s StrataVision 3d PC for three-dimensional modeling, rendering, morphing, and animation. One of its advanced features, SuperSculpting, lets you push, pull, twist, or bend an object as if it were made of clay. Another option, grid transformation, lets you visualize a math function or an array of scientific data in three dimensions.



With StrataVision 3d PC you can create complex 3-D graphics on your IBM-compatible system.

StrataVision 3d PC imports objects in .DXF format, and texture maps in .PCX, TIFF, and 32-bit .TGA formats. It exports in .FLC, .FLI, .PCX, TIFF, and 32-bit .TGA formats, letting you output rendered images for print, desktop publishing, multimedia, and video. The program ships with libraries of 50 textures and 20 metallic table shaders.

•List price: *StrataVision 3d PC, $995. Strata Inc., 2 W. St. George Blvd., Ancestor Sq., #2100, St. George, UT 84770; 801-628-5218; fax, 801-628-9756.*
Circle 409 on reader service card

NEW

New Touch-Screen Monitor Braves the Harsh World

If you put a touch-screen monitor in a public kiosk or multimedia booth, you should be concerned that the monitor will hold up to the fondling and poking of the world at large. **MicroTouch Systems** has recognized this and introduced the TruePoint DS-33 Touch Monitor, combining optical bonding for

Graphic by Scott Schuler

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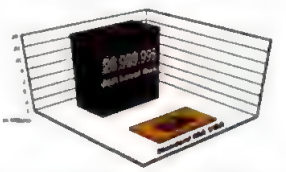

Video Performance Under Windows
i486DX2/66 CPU, Winmarks V.2.5 High Score Wins

In fact, the EVOLUTION IV utilizes an advanced ZIF (Zero Insertion Force) socket, making upgrading as simple and economical as dropping in a new CPU chip. This powerful system is even upgradeable all the way to Pentium™ processing!

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strength, gasket-sealing for water-tightness, and glass overcoating for scratch- and wear-protection. The monitor itself is a 14-inch Mitsubishi Diamond Scan 4533 with a dot pitch of .28 mm and a maximum interlaced resolution of 1,024-by-768. The screen uses MicroTouch's Clear-Tek 1000 analog capacitive touch technology.
•List price: *TruePoint DS-33 Touch Monitor, $1,595. MicroTouch Systems Inc., 55 Jonspin Rd., Wilmington, MA 01887; 508-694-9900; fax, 508-694-9980.*
Circle 408 on reader service card

NEW

Digispeech Attaches a Sound System to Your Parallel Port

After concentrating its efforts on audio solutions for the education marketplace, **Digispeech** is now shipping a product for consumers. The Digispeech Port•able Sound Plus is a two-piece, 16-bit external sound system that fits in your briefcase and attaches to the parallel port. The main unit has audio in, line out, microphone, and speaker jacks, plus a pass-through printer port so you can connect to the printer even with the sound system attached to your parallel port. The speaker unit has a built-in speaker and microphone plus a headphone jack and a pop-out stand. (If you already have speakers, Digispeech offers the main unit by itself, simply called Port•able Sound for $169.95.) The two together, with a carrying case, weigh less than 2 pounds.

Port•able Sound Plus lets you use sound whether you're in the office or on the road.

The Port•able Sound Plus is compatible with all multimedia authoring programs that run under Microsoft Windows 3.0 with Multimedia Extensions, or Windows 3.1. It supports internal sound cards such as Sound Blaster Pro, Ad Lib Gold, and Pro Audio Spectrum. Digispeech is shipping an abridged version of its Show & Tell for Kids with Port•able Sound Plus. It's an easy-to-use, Windows-based multimedia authoring program designed for young people or even first-time multimedia authors.
•List price: *Digispeech Port•able Sound Plus, $198.95. Digispeech Inc., 550 Main St., Suite J, Placerville, CA 95667; 916-621-1787; fax, 916-621-2093.*
Circle 411 on reader service card

BRIEFS

SYSTEMS AND MONITORS

PCs comprised of the DTI series of ISA models ($1,599 to $2,748) and the DTE series of EISA models ($2,536 to $3,095). All models feature VESA-compliant local-bus video and support for Intel OverDrive processors. Wang is offering over 30 peripheral and software options in order to deliver built-to-order, ready-to-go solutions. Base configurations include 4MB of RAM and 130MB and 210MB hard disks in the DTI and DTE series, respectively.

To go with the new line of systems, **Wang** is shipping two new monitors: the ASI-MON-14 ($432), a 14-inch Super VGA unit; and the ASI-MON-15 ($649), a 15-inch Super VGA unit. 800-835-9264, 508-459-5000

ViewSonic is shipping a new 17-inch color monitor that supports noninterlaced resolutions from standard VGA to 1,600-by-1,280. The ViewSonic 17 ($1,599) has a flat square screen with a.28-mm dot pitch, and DQ-DAF (double quadruple dynamic astigmatism focus) technology that uses two lenses rather than the standard single lens to increase the focus of an image by up to 20 percent. The technology also reduces moire—visible dot patterns—at all resolutions. 800-888-8583, 909-869-7976; fax, 909-869-7958.

For CAD/CAM and professional graphics environments, **Epson America** has added the 20-inch Professional Series II Monitor ($2,749) to its product line. The color monitor features resolutions up to 1,280-by-1,024, refresh rates up to 76 Hz, and a dot pitch of .31 mm. 800-922-8911, 310-782-0770; fax, 310-782-4235.

SOFTWARE UPGRADES

Computer Associates International is shipping version 5.2 of CA-Clipper ($795), its DOS-based Xbase application development program. The new version has new and enhanced RDDs (Replaceable Database Drivers), including FoxPro and Paradox drivers that allow CA-Clipper to read and modify FoxPro and Paradox data transparently. Also shipping is CA-Clipper Tools ($695), an update to what was once

NEW

Control Your Presentations From Up to 60 Feet Away

If you use a PC for giving presentations to audiences large or small, **Mind Path Technologies** is shipping a handheld wireless remote control that allows you to stay in complete control of the mouse, keyboard, and projection device from up to 60 feet away. The Mind Path IR90 Remote Control consists of an infrared transmitter, a self-powered infrared receiver that attaches to the serial port, and Mind Path Presentation Tools. To move and click the mouse you use the multidirectional MouseDisk in the middle of the remote, and to choose a Presentation Tool you press one of the ten numbered buttons. Among the tools are a Telestrator, for drawing on-screen in real-time, and a Screen Magnifier, for enlarging a portion of the on-screen image.

Mind Path gives you remote control over your presentations.

•List price: *Mind Path IR90 Remote Control, $395. Mind Path Technologies, 12700 Park Central Dr., #1807, Dallas, TX 75251; 800-634-7424, 214-233-9296; fax, 214-233-9308.*
Circle 410 on reader service card

NEW

MainWin Ports Apps to Unix

For Windows software publishers who want to enter the Unix market, **MainSoft Corp.** has released a product called the MainWin Software Development Kit that takes virtually all the trouble out of porting Windows programs to Unix. Using MainWin's compatibility library and toolkit, you can convert any Windows app written in portable ANSI C to a Unix system supporting POSIX and X Windows. MainWin uses the Windows API (application programming interface) and is natively implemented on Xlib so that developers don't have to rewrite source code, and the program can run the same under Unix as it does under Windows.
•List price: *MainWin Software Development Kit, $5,000. MainSoft Corp., 185 Berry St., #5411, San Francisco, CA 94107; 800-624-6946, 415-896-0708; fax, 415-896-0709.*
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PC Week, December, 1992

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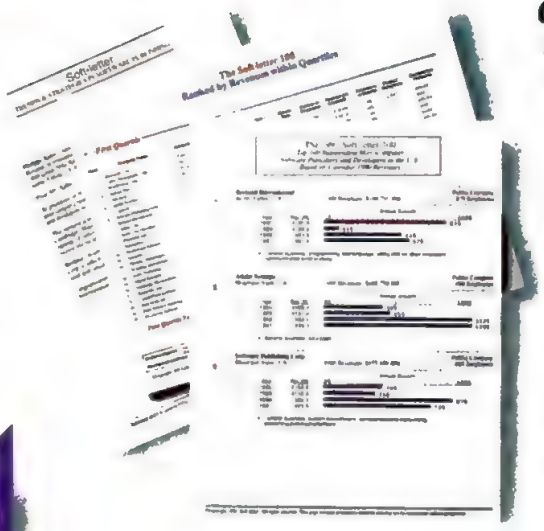

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BYTE, July, 1992

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NEW

Pick Up a Phone and Annotate Documents with SoundXchange

It looks like a telephone stuck to your PC, but **InterActive**'s SoundXchange Model B is actually an innovative tool for recording and playing digitized sound in Windows 3.1. The unit includes a built-in sound board, microphone, and amplified speaker, plus a telephone-style handset for private recording and playing of sound files. If you already have a sound board, the SoundXchange Model A ($149) will connect to it and provide the same functionality. Both models support applications that use Microsoft Multimedia Extensions as well as Object Linking and Embedding for annotating files.

You can't call home, but you *can* annotate Windows files.

•List price: *SoundXchange Model B, $289. InterActive Inc., 204 N. Main, Humboldt, SD 57035; 605-363-5117; fax, 605-363-5102.*
Circle 415 on reader service card

NEW & IMPROVED

Bring DVI Multimedia to Your DOS and Windows Applications

For developers of DVI (Digital Video Interactive) multimedia applications, **Digital Video Arts** is shipping a new Windows kit and an upgraded DOS kit for bringing full motion video to either platform. The NewWorld Development Kit for Windows and the NewWorld Development Kit for DOS 3.0 tap the power of DVI accelerated animation, graphics, video effects, and image processing.

The Windows version is a collection of linkable libraries, header files, and tools that bring full multimedia to Windows. It's libraries are compatible with Microsoft and Borland C++ compilers, allowing object-oriented programming of DVI technology. The DOS upgrade adds still video and audio capture support, plus live play-through support.

•List price: *NewWorld Development Kit for Windows, Version 1.0, $2,395; NewWorld Development Kit for DOS, Version 3.0, $1,295. Digital Video Arts Ltd., Twining Center, #218, 715 Twining Rd., Dresher, PA 19025; 215-576-7920; fax, 215-576-7932.*
Circle 413 on reader service card

BRIEFS

SOFTWARE UPGRADES

Nantucket Tools. It adds more than 250 tools to CA-Clipper and sports a complete NetWare interface. 516-342-5224; fax, 516-342-5329.

E-mail and workgroup applications vendor **Beyond** has released BeyondMail Forms Designer 2.0 ($995), a Windows-based program for designing custom forms for BeyondMail. Unlike version 1.0, the new release is compatible with Windows and DOS flavors of BeyondMail. Now you have the ability to incorporate bitmapped images such as logos in your forms, and there are "rule buttons" that trigger tasks such as data input, database transactions, and form routing. 617-621-0095; fax, 617-621-0096

Modular Software Systems has unveiled Bootcon 2.0 ($79), the boot-time configuration utility that lets you create up to 100 system configurations and choose which to use when you start your PC. The new version has a menu-based interface for easy creation and editing of configurations. It's compatible with MS-DOS 6.0, Stacker, and SuperStor. 800-438-3930, 206-631-5781; fax, 206-631-5779.

To augment its recently upgraded Windows-based Xpress Librarian 2.0 network-backup and data-storage management program, **Emerald Systems** has introduced the Xpress Librarian Pager Module ($395) and the Xpress Librarian Virus Detection Module ($995). Using a modem, the Pager alerts network administrators over their pocket pagers of errors or informational messages generated by Xpress Librarian. The Virus Detection Module automatically scans workstation memory and hard disk boot sectors for viruses. 619-673-2161; fax, 619-673-2288.

CoStar Corp. has upgraded its LabelWriter II software/hardware combination for automatically printing labels in the background. Version 2.0 ($249.95) features a WYSIWYG preview feature, scalable fonts, bar code support, and the ability to use a variety of fonts in a single label. A new Microsoft Windows version of LabelWriter II is also available. 203-661-9700; fax, 203-661-1540.

NEW

Micro Express Puts Multimedia In Its New Portable PC

Micro Express may have taken a step back in the physical design of its new portable PC, but it has leapt forward by making it a fully featured multimedia road warrior. The Multimedia Portable PC measures a bulky 6.8 by 17.5 by 14 inches and weighs a distressing 30 pounds, but it also includes an 8.5-inch color monitor capable of 1,024-by-768 resolution, two floppy disk drives, an internal Sony CD-ROM drive, a 250MB hard disk, an internal speaker, a Sound Blaster card, and a detachable 101-key keyboard. These measurements, however, don't include the two external Labtec speakers that come with the PC, so save some room in your suitcase.

There's nothing lacking in the subsystem, either. It includes VESA local bus video, an Intel 33-MHz 486DX processor, 4MB of RAM (expandable to 32MB), and a 256K cache. It's also upgradable to either a 50-MHz 468DX or 66-MHz 486DX2 processor.

•List price: *Micro Express Multimedia Portable PC, $3,250. Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225.*
Circle 412 on reader service card

IMPROVED

SBT Accounting Extends Its Line

SBT Accounting Systems is shipping two new high-end versions of its Pro Series accounting software. Pro Series 2.5 Unlimited provides complete source code and a LAN site license with each package, while the Pro Series 2.5 Multi User is aimed at small- to medium-size companies that want to upgrade their accounting abilities. Both can run concurrently under DOS or Windows. They include seven modules: System Manager, General Ledger, Accounts Receivable, Accounts Payable, Inventory Control, Sales Orders, and Purchase Orders.

The greatest enhancements are to the General Ledger, which now supports account numbers up to 24 digits in as many as six segments, has the ability to post to any period in a three-year posting window, and provides more account inquiry options for finding information easily.

•List price: *Pro Series Version 2.5 Unlimited, $1,295 per module; Pro Series Version 2.5 Multi User, $895 per module for five users. SBT Accounting Systems, One Harbor Dr., Sausalito, CA 94965; 415-331-9900; fax, 415-331-1951.*
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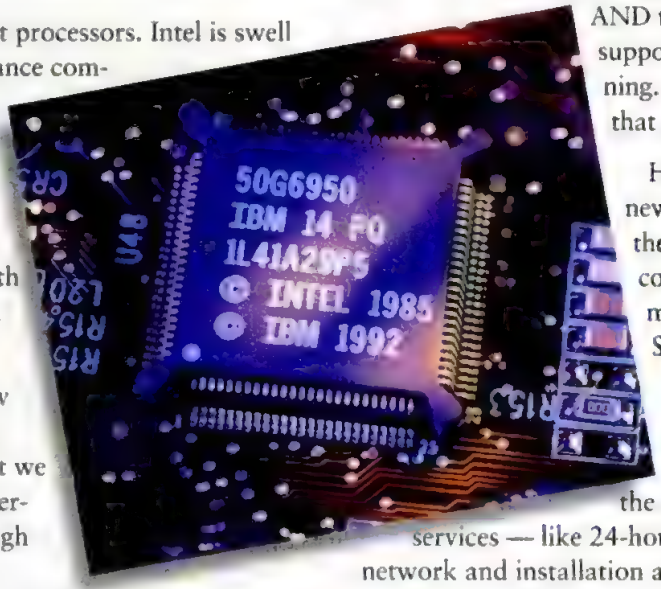

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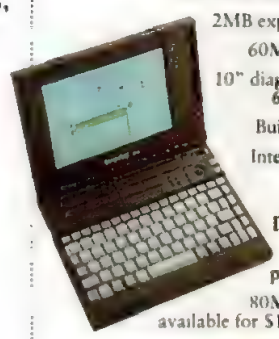
COMPUADD 325TX



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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

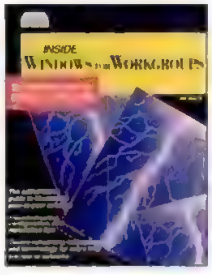
Edited by Carol Levin

Windows Books: The Next Generation

BY DAVID ANGELL AND BRENT HESLOP

Windows NT and Windows for Workgroups promise to take millions of PC users into networking at warp speed. Here are three guides to help voyagers chart their courses.

Helen Custer's *Inside Windows NT* examines the philosophy and architecture behind Microsoft's forthcoming 32-bit operating system, Windows NT. Custer, a member of the development team, writes that "the construction of Windows NT was a software version of the hardware construction documented in [Tracy Kidder's *Soul of a New Machine.*]" But any hope that the text is as accessible as Kidder's should be abandoned. It's closer to a technical white paper that speaks to technically curious readers searching for details on the many layers of this complicated system.



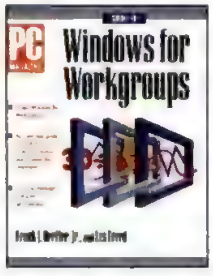
Given Custer's inside-track status, the book offers valuable behind-the-scenes information. An excellent overview of the team's goals—portability, multiprocessing and scalability, distributed computing, POSIX compliance, and government-certifiable security—is followed by an analysis of the main components. The remaining chapters cover technical details of each component, such as the object manager, processes and threads, windows and protected subsystems, and networking.

While *Inside Windows NT* is not for the technically squeamish, Custer does a good job of revealing NT's internal workings.

Jim Boyce's *Inside Windows for Workgroups* takes a hands-on approach to Microsoft's latest networking product. After an all-too-brief overview of network adapters, cabling, and topology, he provides excellent coverage on using Mail and Schedule+, sharing drives, directories, and printers, and on enlisting the Workgroup Connection to bring DOS-based resources on-board. His coverage of data sharing using the Clipboard, ClipBook, DDE, and OLE is unmatched.

The section on nonsupported network protocols leads to a dark void since Boyce uses LAN Manager rather than more affordable third-party solutions for making a TCP/IP connection. And some key questions are left unanswered, such as how to get around Windows for Workgroups' inability to share a modem. Despite some omissions, *Inside Windows for Workgroups* charts the smoothest course through the workgroup frontier.

Among the variety of networking topics that *PC Magazine*'s networking editor, Frank J. Derfler, Jr., and coauthor Les Freed examine in *PC Magazine Guide to Windows for Workgroups* are basic concepts and administration, software mechanics, and third-party products. Their writing is concise and easy to read, but there are some pockets of sketchy information. For example, they advise using a star wiring configuration for "bet-the-business" apps. But instead of giving instructions, they recommend Derfler's connectivity book. Readers deserve at least a few pages on this topic.



They explain how to set up shared disks and printers, use Mail and Schedule+, and use Windows for Workgroups with LAN Manager and NetWare. Oddly, there's no advice on how to integrate the program with the omnipresent TCP/IP protocol, but they do a good job explaining how to connect both Macs and modems.

This *PC Magazine Guide* is not for the user who needs a lot of hand-holding. Instead, it offers sound advice for any Windows for Workgroups user wearing both manager and user hats. □

• **Inside Windows NT,** *by Helen Custer, 24.95. Microsoft Press, One Microsoft Way, Redmond, WA 98052; 800-677-7377. ISBN: 1-55615-481-X.*

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• **Inside Windows for Workgroups,** *by Jim Boyce, $34.95. New Riders Publishing, 11711 N. College Ave., Carmel, IN 46032; 800-541-6789. ISBN: 1-56205-105-9.*

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• **PC Magazine Guide to Windows for Workgroups,** *by Frank J. Derfler, Jr., and Les Freed, $22.95. Ziff-Davis Press, 5903 Christie Ave., Emeryville, CA 94608; 800-688-0488. ISBN: 1-56276-463120-X.*

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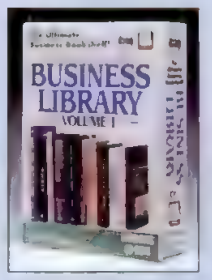
Electronic Books Get Real



Who says reading a book on your PC is a lousy idea? True, you can't exactly cozy up to a monitor and keyboard, but there are advantages to having certain kinds of information available on CD-ROM or floppy disk. Allegro New Media (201-808-1992) is a believer in content-based electronic books. That is, reading material that has proved its value first in hard copy format. Its first Windows-based CD-ROM collection, Business Library, Volume 1 ($59.95), includes 12 titles on business topics—from finance to European business travel.

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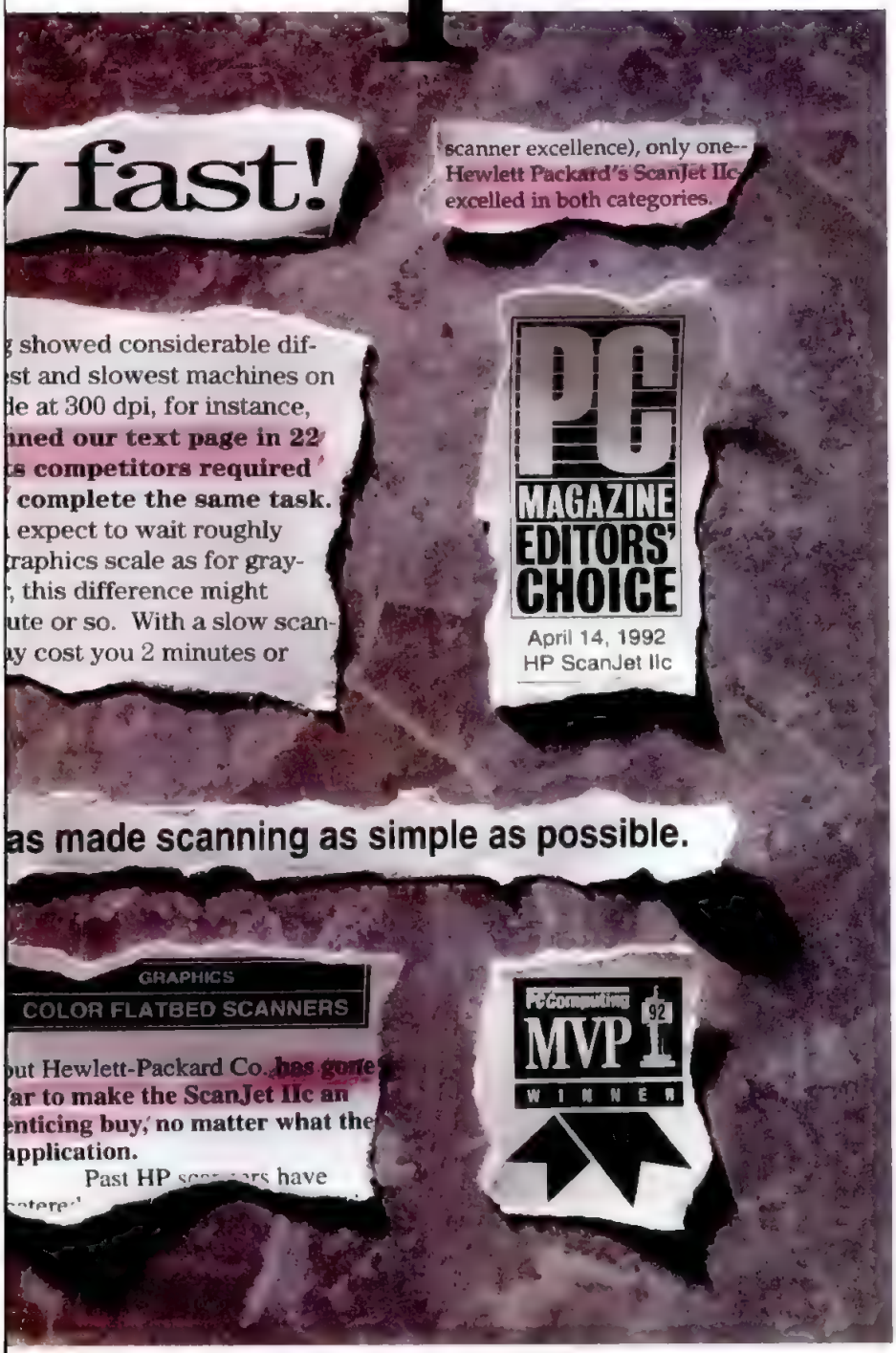

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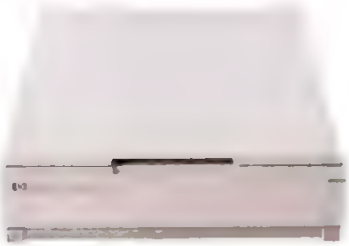

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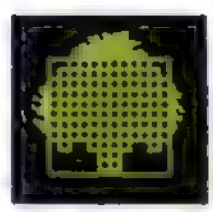

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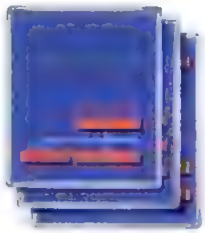

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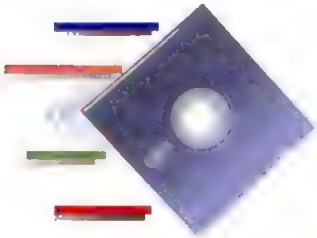

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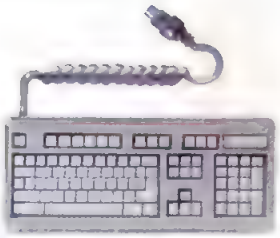

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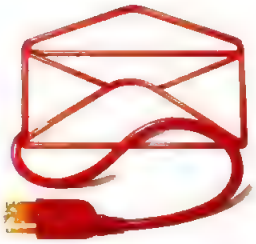

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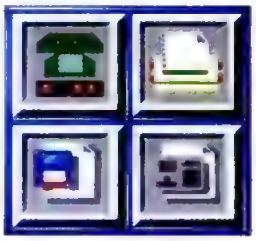

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CIRCLE 120 ON READER SERVICE CARD

Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

Build Versatile Database Apps in VB with Agility/VB

BY STUART R. GREENBERG

Apex Software's Agility/VB database add-on for Visual Basic contains the custom controls that typify a Visual Basic add-on. The controls are similar to those that come with Visual Basic, but they offer powerful database access capabilities.

Agility/VB provides a grid control (AgiGrid) to view and update database files, a text control (AgiText) to manipulate individual fields, a picture control (AgiPicture) to display bitmaps stored in database files, and a button control (AgiButton) to immediately access 16 database commands, including a built-in Query-By-Example (QBE) processor.

In addition to its own proprietary file format, Agility/VB can read and write dBASE files and can even treat comma separated value (CSV) text files as database files. Using the custom controls and little or no programming you can build sophisticated applications, with multiple files accessible on the same form.

The philosophy behind the design of Agility/VB closely follows that of Visual Basic itself. In addition to the custom controls, Agility/VB contains modular database drivers, a library of database functions that you can use from any control (native or third party), and several utility programs for maintaining and browsing database files. Apex will be adding database drivers in the form of Windows DLLs to support other database formats such as Paradox, BTrieve, and ODBC in the near future. To demonstrate this ability, Apex supplies two additional database drivers. One driver allows access to memory-resident database files. The second allows you to build an in-memory database file of disk directory entries.

Agility/VB installs easily into your Windows desktop, generating Program Manager icons automatically. You must add entries for the Agility/VB commands (AGI.BAS) and the Agility/VB custom controls (*.VBX files) to the Visual Basic project list. The custom controls will then appear on the control toolbar.

dBASE file definitions are maintained using the standalone AgiTate utility. AgiTate lets you define files and indexes and pack and undelete records. Memo fields are fully supported, but dBASE functions aren't supported. Therefore, calculated fields must be redefined using Visual Basic functions.

While some applications require access to dBASE files, Agility/VB includes its own native file format, which has numerous advantages over the dBASE format. Unlike dBASE files, Agility files do not use fixed-length fields or records. In fact, records in Agility/VB native files are not required to have the same structure at all. This is important in some applications, where data may or may not be used in each record. For example, if Company Name appears only in business contact records of a phone directory file, blank filler space is not required in the personal contact records. Using dBASE, a user would have to divide the records into two different files, one for business and one for personal contacts, to get the same space savings.

Agility/VB native files can also be defined on-the-fly. If you design a form with a new field on it, Agility/VB automatically adds it to the database format for you. Agility/VB native file fields support all Visual Basic data types. In addition, fields can store binary data.

Agility/VB will automatically generate and maintain an index for its native files if there are more than 250 records in the file and you attempt to search or sort the whole file. You can create an index manually, too.

As mentioned earlier, Agility can also access CSV text files as if they were database files. For example, the following record contains fields for Last Name, First Name, and Grade Point Average:

```
"Doe","John",3.8
```

Agility would access the fields as Col1, Col2, and Col3, respectively, unless you assign names to them. This file format is useful for short lookup tables and has the advantage of being easy to update using any text editor.

The Agility/VB manual provides charts to help users decide which file format to use for a given situation. You can mix file formats within the same application, which allows for maximum flexibility.

A separate View Editor utility allows the user to graphically represent the relationships between files using icons and connecting symbols. Any file format that is supported by Agility/VB may be part of a View. Once it's defined, you access the View as if it were a single flat file. Agility/VB automatically handles all relationships and file I/O.

Records selected from files or Views using either function calls or Agility/VB's built-in QBE processor form a Set, so you can manipulate them without regard to the remaining records in the file or View. By altering the selection criteria, you can further restrict a set at any time.

The use of Sets and Views makes Agility/VB a powerful, easy to use database. Version 1.1A includes Crystal Reports, which allows the user to easily create reports based on any of the file formats that Agility/VB can access. Agility/VB's only drawback is that it cannot operate on multiuser databases. The multiuser capability is slated for the next major release of the product, however.

The ability to adapt to future database technologies combined with the powerful development framework of Visual Basic makes Agility/VB a strong contender against the new breed of standalone database packages, such as Access and Paradox for Windows. □

• **Agility/VB Version 1.1A**
List price: *$189.* Requires: *286, 2MB RAM, 3MB hard disk space, Windows 3.0, Visual Basic 1.0. Royalty-free DLL needs 500K disk space. Apex Software Corp., 4516 Henry St., Pittsburgh, PA 15213; 800-858-2739, 412-681-4343.*
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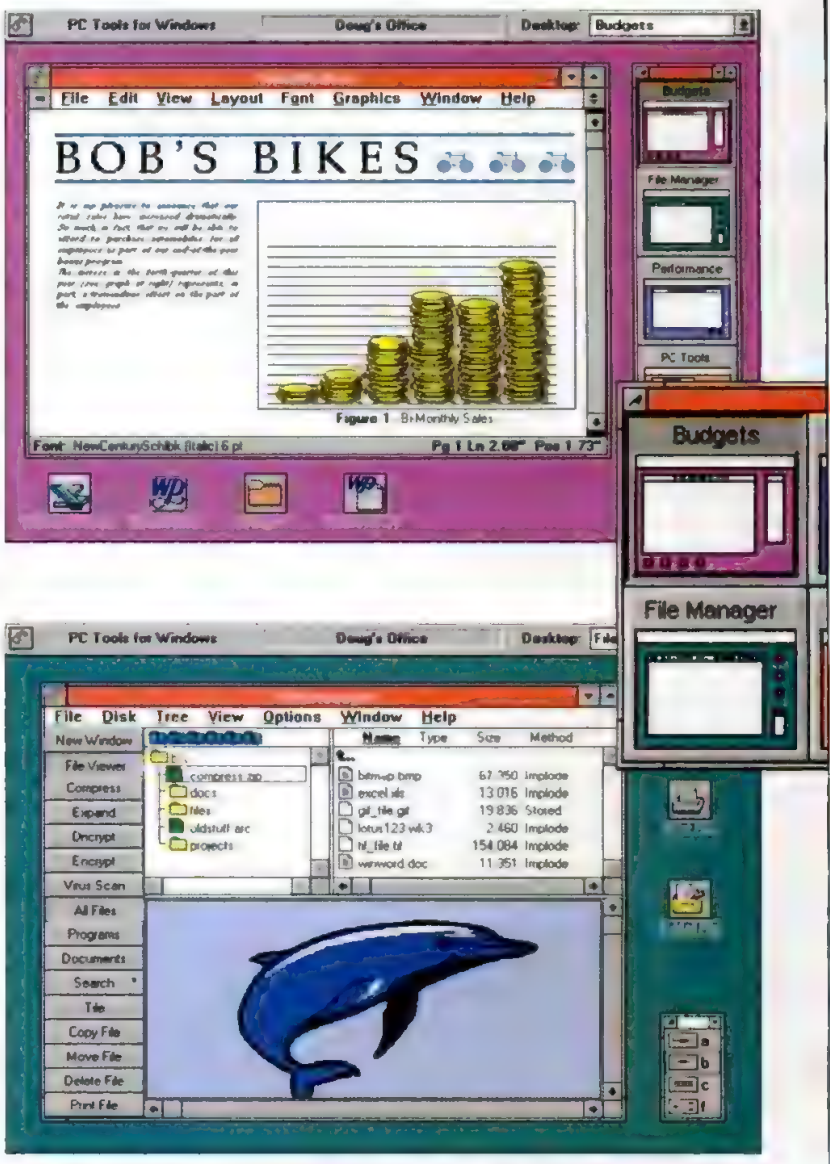

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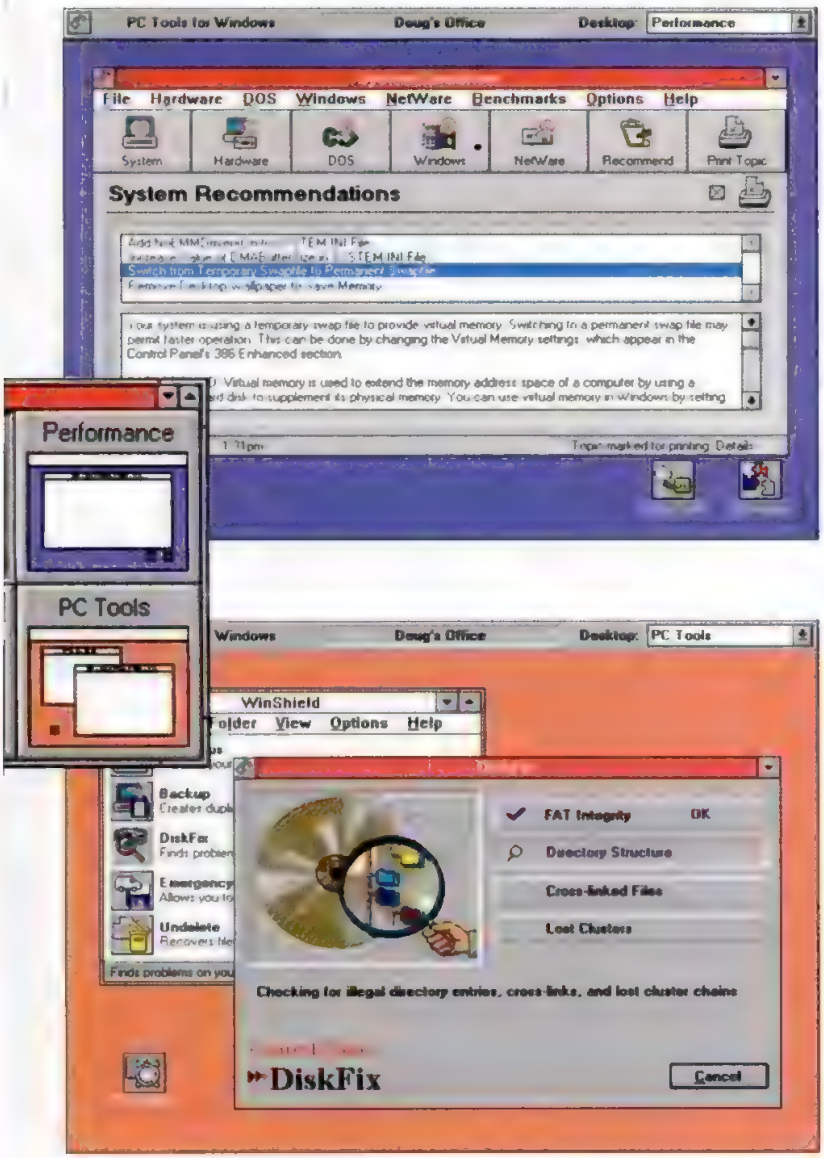

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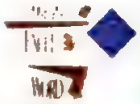

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Michael J. Miller

$99: Why Pay More?

You've seen the ads: Microsoft Access for $99. Borland's Paradox for Windows for $139. Quattro Pro for Windows for $99. Lotus Improv for $99. Looks like the $495 software package may be gone for good. That may mean tougher times for developers, but for users, the news is all good.

It wasn't too long ago that a topflight word processor, spreadsheet, or graphics package would carry a $495 list price. Of course, no one who had any sense would actually pay that much—discount software stores and mail-order resellers routinely offered most programs at 30 to 50 percent off the list price. Besides, big corporate customers nearly always got big discounts. But even the $200 to $300 selling prices we did pay in the past are higher than what we'll pay in the future.

The whole structure of selling software is changing, mostly because the market has grown larger. Microsoft's DOS 5.0 upgrade and Windows 3.0 promotions showed that you could sell millions of copies of operating systems and environments. Windows 3.1 and, to a lesser extent, IBM's OS/2 2.0 continued in this vein.

As the market grows, developers are shifting from trying to get new customers to focusing on existing computer users. For a long time, software vendors gave their best prices to their existing customers in the form of well-priced upgrades. This seemed to be a sound policy—after all, customers were getting extensions of products they had already paid good money for.

Soon, software companies began to apply the same strategy to their competitors' customers. Several discovered the value of the *competitive upgrade*, marketing their new products as upgrades to entrenched standards. Borland started this in a big way, selling its Quattro spreadsheet to Lotus 1-2-3 customers who weren't going to pay list price when they already owned a full spreadsheet.

As the market for Windows applications exploded, lots of vendors decided that they needed to gain market share in the Windows world, and competitive upgrades from DOS and Windows programs began to show up everywhere. In some cases, vendors asked for proof that you had purchased the product you were "upgrading" from. But many stores were lax about enforcing that rule, and most determined software buyers found they could get new software at upgrade prices whether or not they had a legal copy of a qualifying product.

When Microsoft presented Access at a $99 introductory price as a "competitive upgrade" to Borland's $795 Paradox and dBASE products, Borland complained. But turnabout is fair play, Microsoft argued. In any case, the product is selling like gangbusters. So, apparently, are $139 Paradox for Windows and $99 spreadsheets.

PRICE-ELASTIC

Surprise, surprise. The software market is proving to be price-elastic. You can indeed sell many more copies of a $99 package than a $495 one. This is not news to a lot of smaller companies. Selling $99 packages through the mail has proved amazingly successful for products ranging from Quicken to Alpha Four to Mathcad.

One thing the biggest software companies may not have grasped yet is that these price decreases are probably not "limited-time offers." Oh, developers may try to raise their prices, but once consumers get used to the idea that software is worth about $100 a package, it will be hard to convince them to pay $495.

Low prices don't necessarily foretell bad times for the software industry. The total PC market has grown to something like 80 million PC users. That means it's possible for developers to sell a lot more units than before.

Of course, if a software

Software price cutting may be war for developers, but for users the news is good.

Illustration by Daniel Baxter

vendor sells, say, 500,000 copies of a $99 package, the revenue should be roughly the same as if the company sold 100,000 units of a $495 package. But of course it isn't that simple. The entire business model of most software companies is going to have to change—as will the software itself.

To begin with, companies suddenly have to become a lot more concerned about the cost of goods—how much it costs them to produce the disks, manuals, and packaging in each copy. As revenue shrinks, the cost of goods becomes a much higher percentage of the overall price. Manuals are especially expensive, so don't be surprised if they get smaller. Look for more software companies to include on-line documentation, particularly on CD-ROM, and to charge extra for manuals.

The changing cost structure may also have an impact on distribution channels. The amount of revenue a software company gets from each sale depends in part on the deals the company works out with its distributors. For a typical $99 sale from a computer retailer or software store, the publisher gets roughly $55—the rest is split between the distributor and the store. Developers naturally want more of this money. That's why more and more software will be sold directly from the publisher via advertising or direct mail—and why more will be sold from hardware makers, who will print the software manuals themselves.

HIGH COST OF SUPPORT

The biggest impact may well be felt in the area of support. Surprisingly, most software executives I talk to can't answer two simple questions: How many support calls do you get for each unit sold? And how much does each call cost you? Those who can answer the questions give very interesting replies. Numbers range from three calls per unit to one call for every five units, costs from $20 to $40 per call. The rule of thumb is that a developer can handle one support call and still break even on a $99 program. But if the company has to take two or more calls, it loses money.

One answer is for the publisher to charge for support. That may make sense in some limited areas—say, if people want accounting *advice* more than information on how to run an accounting software package—but in general, it's the wrong solution. It might help a company's short-term bottom line, but it's treating the symptom rather than the underlying problem. Companies have already begun to lower support costs by using on-line services, fax machines, and Touch-tone answering machines. But while these approaches may help, they don't address the real problem either.

The high cost of support may force software vendors to see what customers already know: that today's software is just too complicated. For a long time, people have been talking about making software easier to use. But now vendors are beginning to respond with usability testing, on-line support, and built-in wizards or agents. Not only do these technologies make software easier to use, they also make it less expensive to support. The best way to reduce support costs is to design packages simple enough to use so that they don't require much support.

The software price wars will have a great impact on the software we use. We'll get better user interfaces, better (or at least shorter) manuals, and lower prices. Not bad—not bad at all. □

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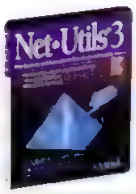

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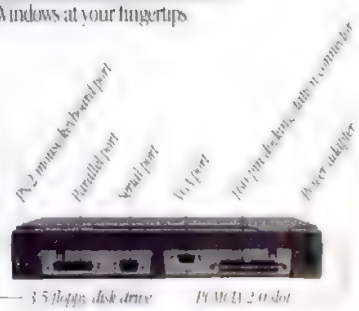

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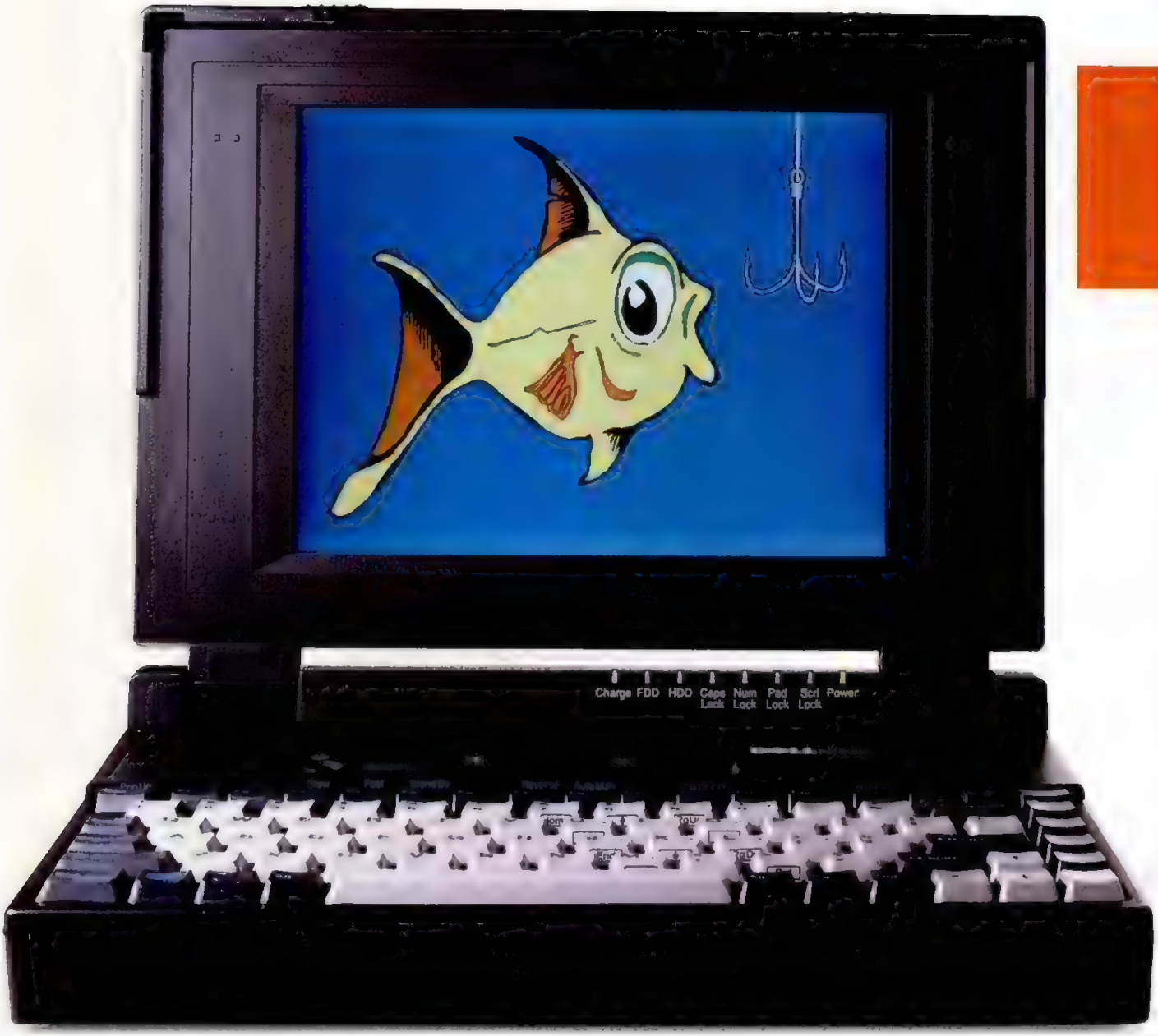

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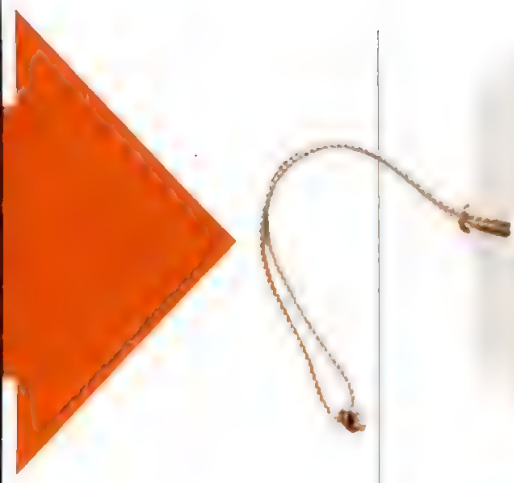

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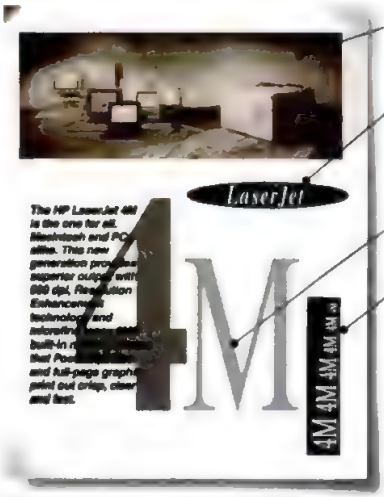

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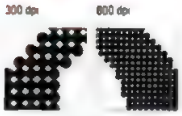

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Bill Machrone

Discontent with Content

Sometimes you need to get away to get perspective. The computer industry doesn't lack for trade shows, symposia, forums, or meetings to attend. In fact my largest incoming mail folder is labeled "conferences." I could easily head out on the road on January 2 and not be seen around the office until Christmas. Most conferences are resolutely focused: The Paradox User Forum. OS/2 Technical Interchange. Windows Hardware Engineering Conference.

One soiree differs from the others: Esther Dyson's PC Forum. This one virtually ignores the here and now in order to look farther down the road at the events and technologies that will shape the industry in the coming years. Dyson, the well-known columnist and publisher of her own newsletter, *Release 1.0,* is the catalyst for the event, deciding on the major focus of each year's forum and assembling the speakers who are making a difference in that area. Of course you see the usual crowd, the captains of the PC industry. What makes this conference so interesting, however, is the assemblage of people who will affect the industry in years to come.

MANAGING THE INFORMATION GLUT

This year's theme was "Content is Key," focusing on all the ways to infuse and extract meaning from the textual and data-oriented information bases that we all live by. The amount of information available is exploding at an almost unimaginable rate. Without tools to organize and access it, meaning is irretrievably lost. Likewise, we need good authoring tools to impose order on the data and give the recipients choices of how to retrieve and use it. The presenters at the conference were leaders in the areas of authoring and extracting information. Many of the products are unfinished, but their authors were willing to talk about them and show them as works in progress to drum up interest in their projects and support for nascent standards.

David Liddle, late of Xerox PARC, Metaphor Systems, and IBM via Pioneer Partners, and now heading think tank Interval Research, gave a reflective presentation on the end of computing as an occupation unto itself. Just as scrivening, the job of writing without regard to content, died as literacy became commonplace, so, he argues, will the care and feeding of computers pass as a major focus. With more than 100 million PCs in the market, computers are commonplace. What you do with yours is inherently more interesting than the fact that you have one.

Historically, programmers controlled all the input and output of a system. Proper procedure for an applications programmer was to say to the user, "Just tell me what reports you want and how often you need to see them." He would then go off and design the file structures, input formats (cards, forms, screens), processing logic, and output formats. What you got was an inflexible, closed-ended system that automated a specific process. With luck, it integrated into other data processing systems, but as often as not, it didn't. Ad hoc reporting helped a lot, but was dependent on proper construction of the underlying data structures. Too often, the answer to your query was, "You can't get there from here," or, "I can't even understand the question."

We're drowning in a sea of information. Fortunately, help is on the way.

We're in danger of drowning under a deluge of information bases, online news services, electronic mail, bulletin board services, and publications, both electronic and print. The information available to us greatly exceeds our ability to absorb it. Worse, the electronic medium, bereft of the headlines and other visual cues that help us navigate through print media, gives us no sense of relative importance and makes it difficult to skim. We're also in immediate

Illustration by Daniel Baxter

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CIRCLE 008 ON READER SERVICE CARD

Bill Machrone

danger of running out of bandwidth, not to mention storage capacity. The presenters at the PC Forum were there to provide specific solutions to these problems.

ELECTRONIC BOOKS

Some solve it by prestructuring the data. A number of electronic books, aimed at both the PC and Mac markets, stand ready to enhance your reading experience with indexing, searching, graphics, annotations, glossaries, sound clips, animation, and bookmarks. As one who has pooh-poohed such efforts in the past, I can finally say that the products are tolerable, even desirable. Books on-disk are going to be big, and now that the software works, smaller, cheaper laptops will be the gating factor.

Other products, such as Beyond Mail, use rules engines to carry out your wishes for filtering and prioritizing your e-mail. Given the volume of mail I receive and its being spread across five mail systems, I can appreciate the need for such products. My biggest problem with these approaches is that my filter for what I want to see changes daily. I could reduce it to six or so scenarios, but it feels like more trouble than it's worth.

One of my favorite approaches to the information glut is an emergent product from Oracle called ConText. You may have seen the underlying engine in PowerEdit, a grammer checker. You need a parsing engine that understands sentence structure and parts of speech—that's PowerEdit. Add to it a 40MB database filled with meanings of words in various contexts, give it the ability to see those contexts in terms of the paragraph and document, and you've got an engine that can extract the meaning and most important ideas from unstructured text. The current implementation lets you move a slider. As you do, more and more words on the screen become grayed out, till you're left with the barest skeleton of meaning. The ultimate skimming tool—superb!

On the other end of the spectrum is PenMagic's LetterExpress. It takes minimal information and turns it into a letter, cleverly combining personal information that you provide with boilerplate to create personalized correspondence.

Now imagine the ultimate: You create a terrific letter using LetterExpress. You and the software get the tone just right. Your recipient uses ConText to return it to its elemental form. Is this progress? □

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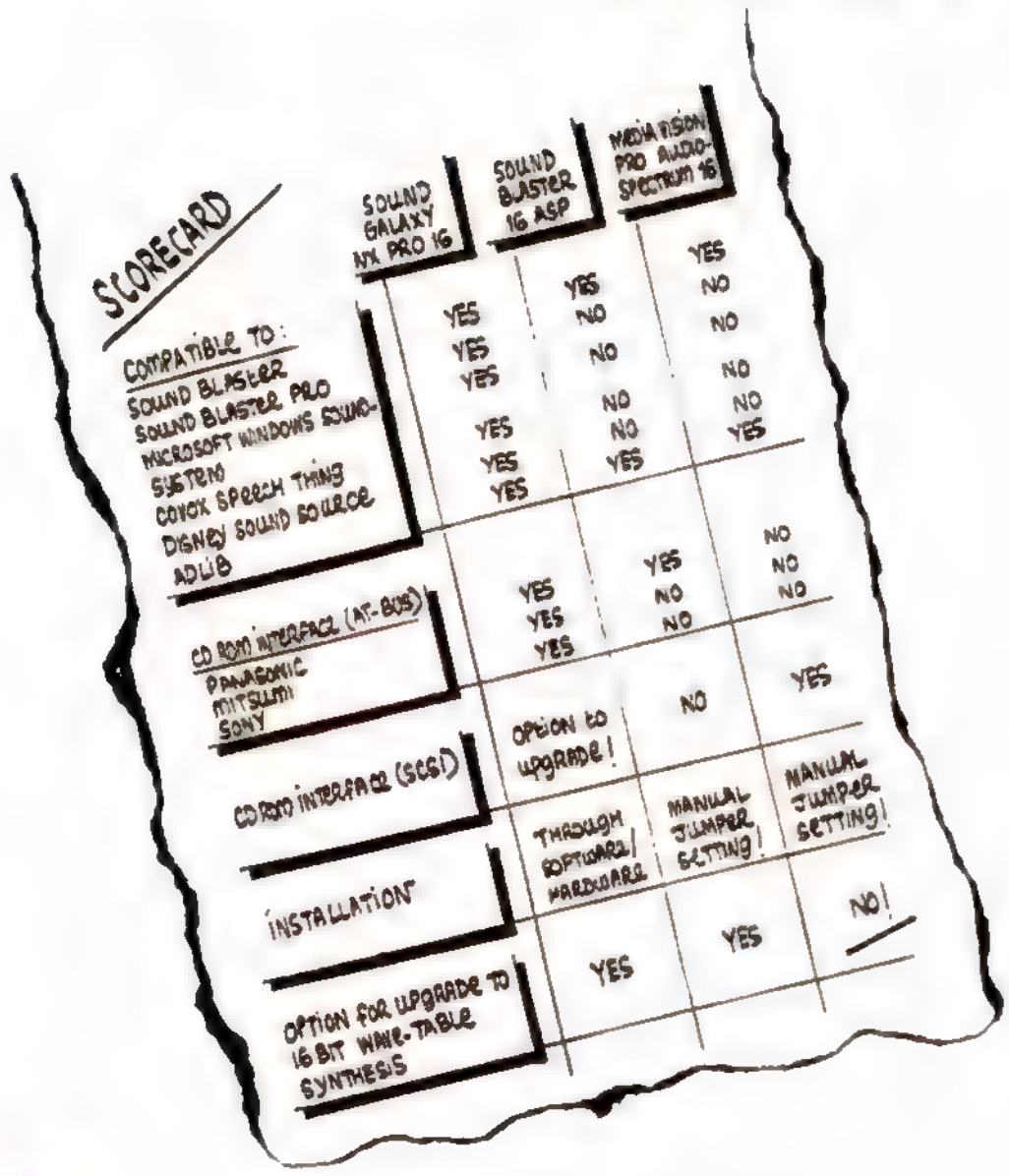

SCORECARD

	SOUND GALAXY NX PRO 16	SOUND BLASTER 16 ASP	MEDIA VISION PRO AUDIO SPECTRUM 16
COMPATIBLE TO: SOUND BLASTER	YES	YES	YES
SOUND BLASTER PRO	YES	NO	NO
MICROSOFT WINDOWS SOUND SYSTEM	YES	NO	NO
COVOX SPEECH THING	YES	NO	NO
DISNEY SOUND SOURCE	YES	NO	NO
ADLIB	YES	YES	YES
CD ROM INTERFACE (AT-BUS)	YES	YES	NO
PANASONIC	YES	NO	NO
MITSUMI	YES	NO	NO
SONY	YES	NO	NO
CD ROM INTERFACE (SCSI)	OPTION TO UPGRADE!	NO	YES
INSTALLATION	THROUGH SOFTWARE/ HARDWARE	MANUAL JUMPER SETTING!	MANUAL JUMPER SETTING!
OPTION FOR UPGRADE TO 16 BIT WAVE-TABLE SYNTHESIS	YES	YES	NO!

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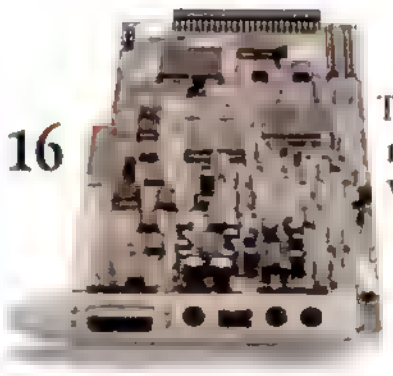

These are the truths. **Sound Galaxy NX PRO 16** gives you more extras at really no extra cost than Sound Blaster or Media Vision. In addition to supporting Sound Blaster Pro and Microsoft Windows Sound System, it is also compatible with AdLib, Covox Speech Thing and Disney Sound Source.

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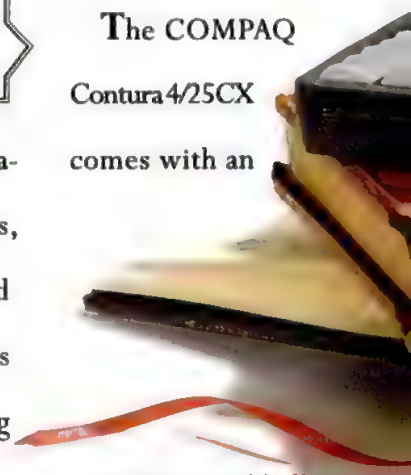

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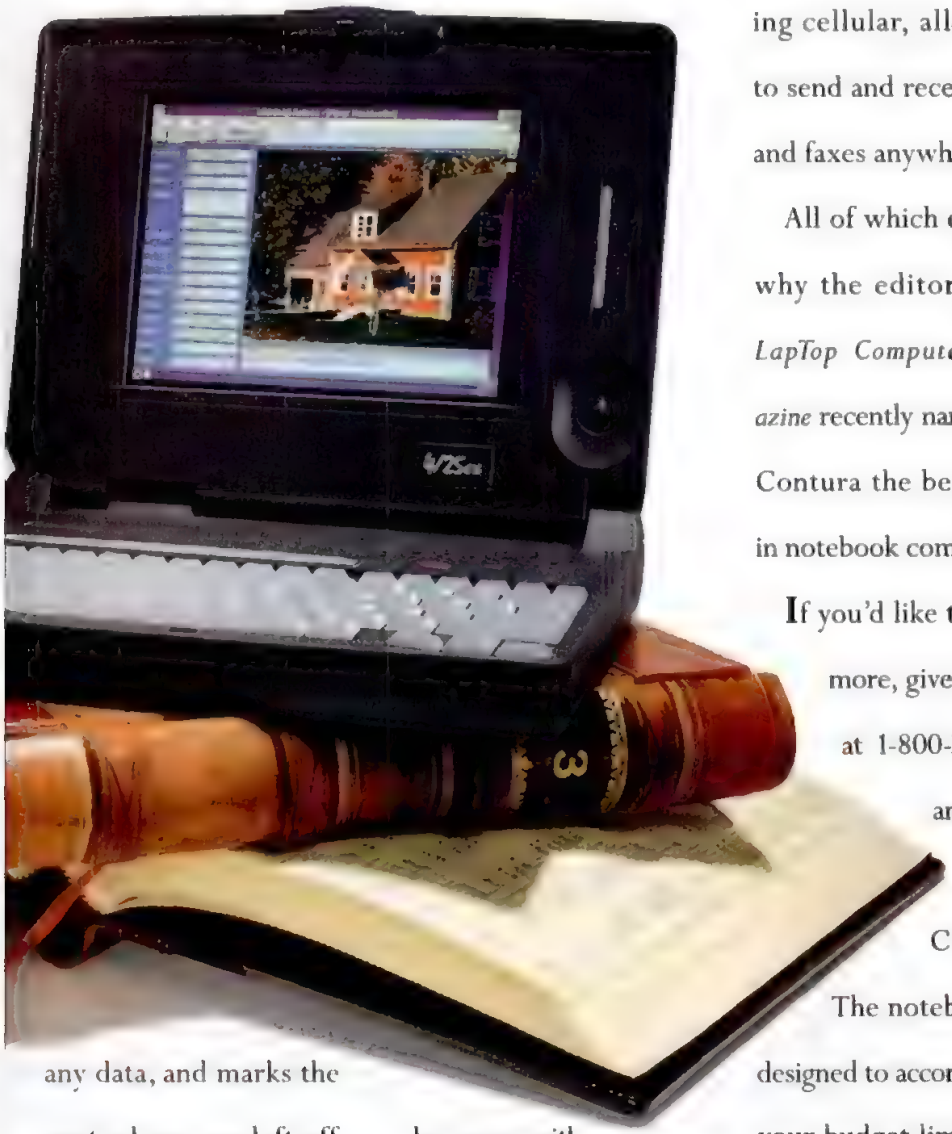
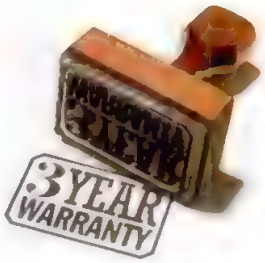
All of which explains why the editors at *PC LapTop Computers Magazine* recently named our Contura the best value in notebook computers.

If you'd like to know more, give us a call at 1-800-345-1518, and ask us about Contura. The notebook PC designed to accommodate your budget limitations, not constantly remind you of them.



*Thanks to our advanced graphics accelerator, Contura blows the doors off most other Windows notebooks. In fact, it runs Windows 30% faster than most 486 machines.**



*Nothing is backed like a Compaq because nothing is built like a Compaq. Contura includes a free three-year, worldwide warranty with a year of on-site** service in the US or Canada.*

COMPAQ

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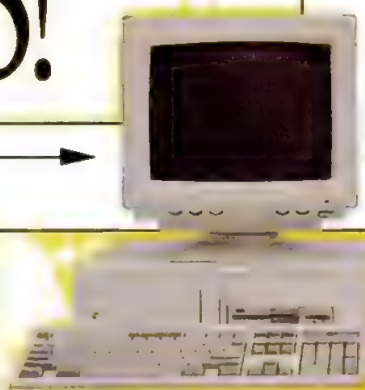

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CIRCLE 125 ON READER SERVICE CARD

John C. Dvorak

BBS Easy Target in FBI Bust

In February the FBI and the Software Publishers Association swooped down on the Ohio home of Rusty Hardenburgh and confiscated over 100 computers used to power Rusty–N–Edie's BBS. Mysteriously, no charges were filed immediately. The board was simply shut down, and its users were screwed for a week before Rusty put together a makeshift system. The board had allegedly posted commercial software among its gigabytes of shareware, freeware, .GIF images, and other software.

Taking the side of the BBS operator, the ACLU says that a BBS is not unlike a printing press. If the operator is found guilty of a crime, that's one thing, but to jump into someone's business and grab computers is unconstitutional. The FBI argument is that this is evidence gathering. But the computers are not evidence of anything. To verify that pirated software is being distributed, make a phone call and download something! An activity log might provide evidence, but what joker in the police department knows where to find it? This practice is harassment, pure and simple. One intelligence-gathering service has found over 2,000 BBSs specializing in pirated software, out of the 25,000 it monitors. Hundreds of boards could have been busted.

But Rusty and Edie had made a lot of enemies in the BBS community because they had a reputation for reposting nudie .GIFs from other sources, removing the original promotional material and inserting their own promotional stuff—a practice despised by BBS operators. Many bulletin board services barely eke out a living and would be profitless if it weren't for the peculiar demand for downloadable pictures of people in the buff. Rusty had also done little to make friends in the BBS community. It's one of the few BBSs that do not even post the number of other BBSs for the convenience of subscribers.

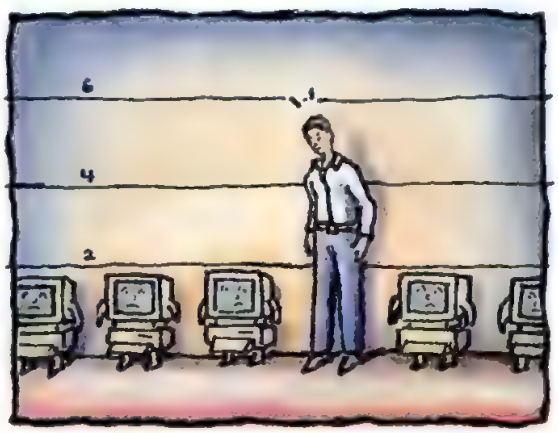
So when Rusty was busted, the community did nothing and said nothing. Many operators quietly smirked or applauded. Yes indeed, the SPA picked a convenient target.

But this was not an outrageous pirate board bragging about bootleg software or posting credit card numbers. The fact is that Rusty's board promoted shareware as much as anything else. Shareware is a legitimate threat to the software companies that sponsor the SPA. There are about six huge BBSs in the U.S., and they all promote shareware. Rusty's reputation for having commercial software on the board for downloading made it the easy first-strike target in a long-term campaign to put shareware authors and small-time operators back into the underground, where they won't affect sales of the big boys.

Why didn't the SPA call to warn them and ask them to audit their software, like the SPA normally does? Why didn't it leave the board in place—under guardianship—until the man was found guilty of something? Instead the FBI, at taxpayers' expense, was called in. Well, actually, it was worse. Apparently the FBI had been watching this board for about two years!

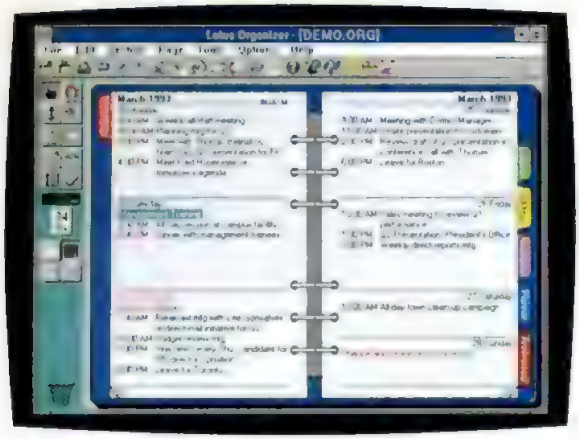
It was when Rusty threatened to expand to 500 lines that the FBI got serious. Gee, what a coincidence: A major source of shareware is obliterated.

The SPA should protect the BBS operator from having equipment confiscated. These are computers, not drugs or illegal weapons! This rationale means any *PC Magazine* reader suspected of having pirated software may have a PC confiscated. As in Stalin's Russia, it only takes a tip from an unfriendly neighbor. The SPA is that neighbor today. A disgruntled employee or jilted lover will be that neighbor tomorrow.

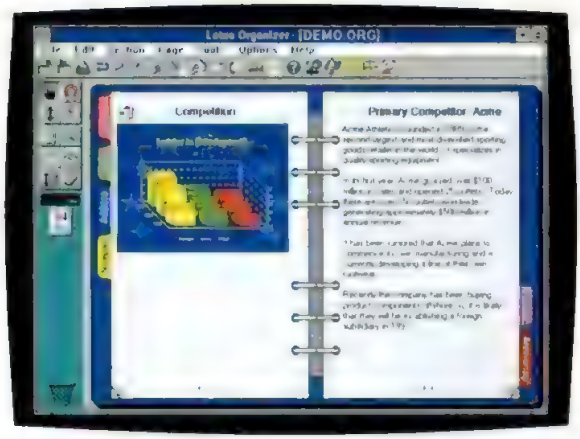


The FBI gathers "evidence" and the ACLU cries foul. Meanwhile, a major source of shareware is obliterated.

Illustration by Daniel Baxter



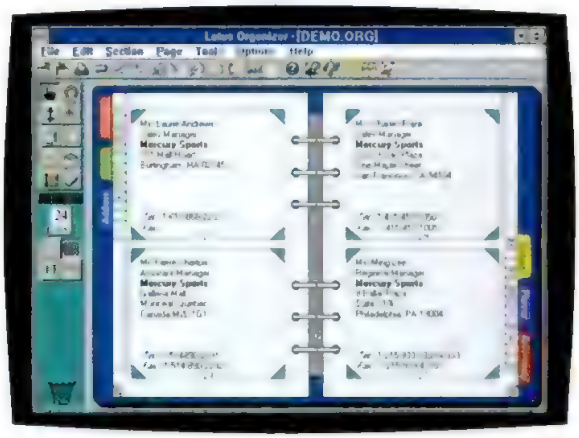
With Organizer, you can change the format of your calendar as you work: view it by day, by week, or even two weeks.



In the Notepad section, you can make free-form notes, import files or create a dynamic link to other Windows™ applications.

So, what does your day look like?

The To Do section lets you prioritize tasks as you enter them and view entries by due date.



Sort your address book in any of four formats: name, company, zip code and type of record. An Auto Dialer lets you simply drag and drop to dial a number through your modem.

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So if you'd like to increase your productivity, efficiency and control over your daily business life, call Lotus at **1-800-872-3387, ext. 8488.** Or take a little time and visit your Lotus Authorized Reseller.

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John C. Dvorak

Inside Track

Bonehead '93 Dept.: Every so often, while lamenting Microsoft's domination of the industry, you run into **an unbelievable idiocy.** The bell in this category rang twice—indicating the **dunce award** for Novell in the "Get a Clue" category of Final Jeopardy—when Novell sent out a memo to the press that was pathetically trying to **weasel** $350 out of the media to attend Brainshare '93. Just listen to this one and roll your eyes.

Each year Novell has an event called Brainshare. The press has **no reason** to attend the $1,595 conference except to report on it and perhaps to keep up with Novell's technology and current ideas in order to discuss them intelligently in the future. It's a conference designed for Novell installers, dealers, and developers. Now, obviously, it would be in Novell's **best** interest to encourage the press to attend the event so the press could **gush** over the inspired hype. But Novell, for some odd reason, thinks the press should pay $350 to attend so they can "attend product demos" and have "one-on-one interviews with key executives." Well, GAWL-LEEE! A real GEN-U-WINE one-on-one interview for only $350. **What a deal! Not!**

Besides the fact that these jokers should be begging the press to attend, if the press *must* pay $350 to attend this can easily be considered **checkbook journalism** and a **violation** of almost every ethics code of every daily newspaper in the country. Hey, boys. GET A CLUE!!! I've been a big fan of Novell over the years, but I **have to wonder** how such a decision could be made. In my opinion, it's a bad sign overall. A fact of modern business: **discouraging press coverage is just plain stupid.** End of lecture.

So Why Are We Copying the Japanese Role Model Dept.: If you didn't already know, the Japanese, who are in the midst of an economic downturn, expect the five leading Japanese computer makers to see a 72 percent drop in net profit for the current fiscal year. This follows a 50 percent drop last year. NEC, the **dominant** PC maker in Japan, is expected to **post a loss** for the first time in 18 years according to the Kyodo News Service. This is all compounded by **sluggish** semiconductor sales both in Japan and elsewhere. Gee, things seem just fine at Intel and Cyrix. I wonder what they're doing wrong there in Japan. My advice: let's not copy them.

While Japan is in the midst of an economic downturn—sluggish semiconductor sales and huge losses for PC makers—things seem fine at Intel and Cyrix. My advice: Let's not copy the Japanese.

Something Weird About This Dept.: So I'm reading this report about the IBM hunt for the new CEO to replace Akers, and I see that Reuters names the **headhunting firm** that IBM is using. It's a Chicago-based company appropriately dubbed **Heidrick & Struggles Inc.** Struggles?! Man oh man, you don't have to write humor in this business. It comes right to you.

Books of the Month Dept.: Most books about the computer business are pretty **dry.** Not so with David Sheff's new book from Random House. It's called *Game Over*, and it details the history of the computer game business and **Nintendo's incredible success** in particular. Anyone who is interested in marketing or the history of computers and technology should **demand** a copy from their book seller. Highly recommended.

Finally, if you have children, **rush to the phone** and order a copy of the comprehensive 607-page *Prides' Guide to Educational Software.* It's $25 from Good News Publishers at 708-682-4300. There is nothing like it. Killer book. Definitive. **Highest** recommendation. Five stars.

I was Right All Along Dept.: From researcher David Powis-Dow comes this memo:

"I read a PC Magazine column of yours recently where you were saying there are rooms to be had in Las Vegas during Comdex. Well, I happened to be indexing an article in Tour & Travel News on the new Theme Park Hotels they're building in Las Vegas. Since the numbers seemed to support your argument, I thought you might be interested. There were 77,557 rooms in Las Vegas in '92, with 10,000 more opening in '93. Current occupancy rates are about 85 percent, with slow tourist growth predicted. The occupancy rates could drop to around 80 percent in '94, which is what happened the last time there was a big spurt in building, because three new Theme Park Hotels will add 10,400 rooms in late '93 and early '94 (though probably none of them will open in time for Fall Comdex. The Hotels are the MGM Grand Hotel, Casino & Theme Park (5,000 rooms), the Luxor (2,500), and Treasure Island (2,900). The bottom line is that the older hotels will have to drop their prices to compete. In fact, some hotels will push the fact that they are close to the fancy new hotels!"

I thought you corporate travel planners might need a little **leverage.** Go get 'em! □

Maybe You Don't Need A Multimedia PC With Built-in CD-ROM And Digital Stereo.

Okay, so maybe you aren't really looking for an Intel 486 SX microprocessor that gives you the power to run any MS-DOS software, like Windows 3.1. Or a 107 MB hard drive. And perhaps you find Super VGA with an advanced palette chip that can display up to 16 million colors terribly unimportant. And a complete, computerized voice-mail system that can answer your phone, take messages and give you the ability to retrieve messages—text or spoken—from anywhere in the world might not be what you're looking for in a computer. A send-fax? A modem? Are those things you really need from a computer? How about a CD reference library with seven illustrated editions of books such as *The World Almanac and Book*

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of Facts, Roget's Thesaurus, Hammond Atlas and *The Concise Columbia Encyclopedia?* But you probably don't need any of those. Right?

And then there's In Print, an easy-to-use desktop publisher. But then again you probably don't need to make any signs or classified ads or banners or newsletters.

And then there's *Microsoft Works* with word processing, spreadsheet, database, graphics and communications programs. And there's *America Online*. And *Prodigy*.™ And even the *Sierra Network*. So do you need a computer that comes complete with all that? Or a stereo headphone jack, stereo microphone jack, parallel printer port, serial port, MIDI port and a two-button mouse? Then again, you probably don't really have any need at all for a computer that includes so many things.

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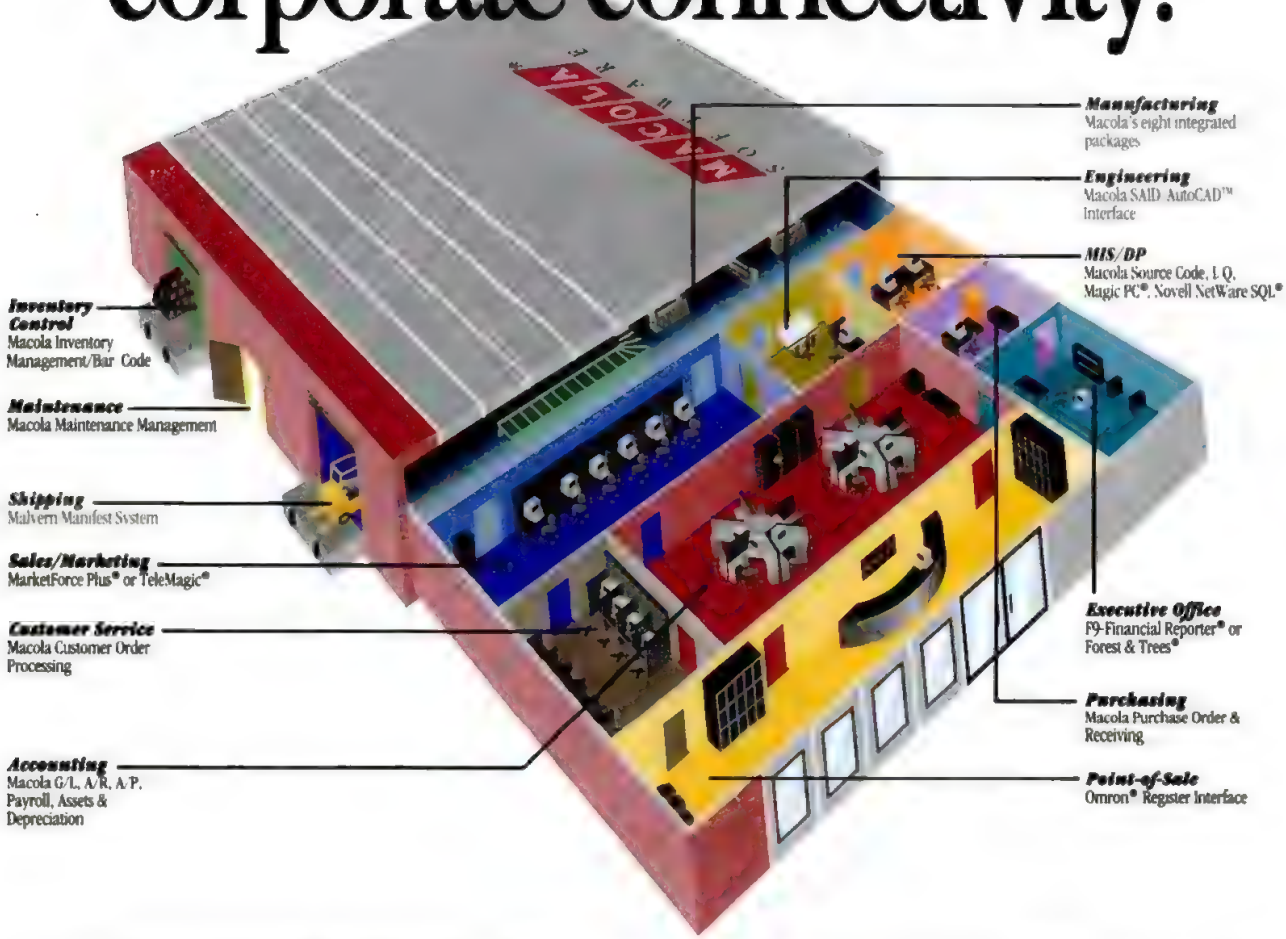

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Jim Seymour

Mainframe Decommissioning

I have a friend whose job is to calculate the future costs of decommissioning nuclear reactors at power plants that have reached the end of their useful lives. It's difficult because there are so many unknowns. And it's frustrating because while it's immensely important for corporate and public-policy planning reasons to know what those costs will be, his work is highly speculative: Those costs won't actually be incurred until a decade or more hence.

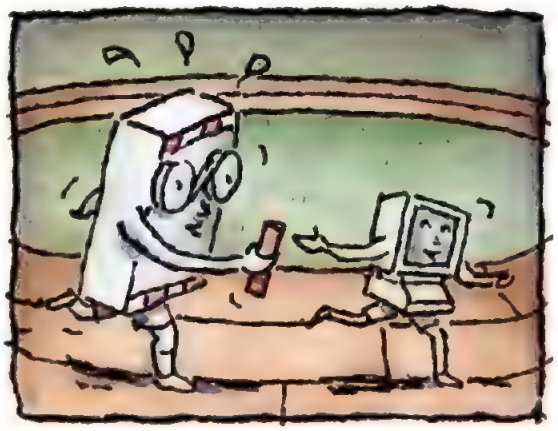
Many PC managers and users are engaged today in a guessing game about how this computing apocalypse will end. I think that as we look toward the end of the mainframe era in computing, and how the growth of networked desktop computers will hasten the end of that era, we can learn something from my friend's line of work.

Some of the problems appear very different, of course. The difficult issues in forecasting the costs of decommissioning nuclear plants deal with the need for disassembling, breaking down, and storing for thousands of years large chunks of the plants themselves (because of their radioactivity). Worker safety, public safety, transportation problems, and the NIMBY (not-in-my-backyard) politics of locating disposal facilities are critical, complex, and closely related.

Trying to attach costs to those processes, many years before they will be incurred and in a very different economic and political climate than the time the work will be done, involves thousands of guesses.

And because the costs of decommissioning those plants must be folded into today's electric rates for those using power from them, those guesses are extremely important.

Similarly, planning and timing the move from mainframes to alternative systems, and funding and timing the acquisition of the *right* alternative systems during that transition, is a demanding job. Like my friend's job, this one is based on thousands of guesses about what will happen, and when, and what the costs will be 5, 10, and maybe 15 years hence. Yet making the right guesses today is crucial to companies' financial health and well-being over the course of the next decade.



Trying to pin a price on phasing out mainframes involves thousands of guesses about tomorrow's economy.

NEVER TOO EARLY

While few companies today can know when they'll turn out the lights for the last time in their mainframe computer rooms, it's hardly premature to begin talking about the process and its consequences.

Physically disposing of mainframes and disk and tape drives will certainly be easy enough. Many companies will keep their big iron until it's essentially valueless, then have it hauled away as high-tech scrap iron. Just as used-up nuclear plants have a negative value—that is, they can't be sold and require additional expenditures to get them out of the way—disposing of mainframes and associated equipment will eventually cost more than the machinery's scrap value.

How long will that take? Longer, probably, than you think. Mainframes still perform important work smaller machines can't handle practically. But that's changing. When the equation finally tilts decisively, mainframes are going to go quickly. The value of used mainframes in the secondary market is going to approach zero in another 10 to 12 years. While large organizations that maintain very large pools of data—Social Security records, airline reservations systems, weather-forecasting databases—will certainly be using mainframes long after most businesses have shed them, those organizations will buy up cheap mainframe processors and stor-

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age as prices plummet. As buyers of last resort, they'll pay pennies on the dollar for the equipment, then squirrel it away to assure a parts supply for years to come.

More important than guessing the residual value of mainframe assets will be our incremental moves away from mainframes over the rest of the 1990s. The most obvious of those steps have already taken place: putting PCs, rather than terminals, on individual workers' desktops, and then linking those PCs through networks. Moving to WANs connecting disparate LANs within a company is the next step, followed shortly by adoption of company-wide client-server architectures. Buying super servers far beyond today's definition of that term will be the last costly hardware step.

Though we always focus on the hardware in planning generational change in computing, the software costs of replacing mainframes will certainly outweigh hardware costs. Here, carefully planned incremental change has real economy. If we begin the transition early and spread software conversion costs over several years, the final tab will be much smaller.

FOOTING THE BILL

Funding this transition will be a bear. No one's going to pay for these moves through selling off redundant mainframe hardware: That big iron must stay in place until the new systems are up and running, and the steadily declining value of mainframe equipment won't come close to paying the bill. Just as those planning decommissioning of nuclear plants must fund the work from present revenues, we have to fund the generational change in computing from present revenues.

Finally, a comforting thought. Over the past several years, people who forecast the decommissioning costs for nuclear facilities now believe that the job will be easier and less expensive than formerly thought. We haven't done much nuclear-plant decommissioning, so early forecasts were on the high side, thanks to our tendency to guess high when faced with an uncertain future.

In the same way, when the final story on mainframe decommissioning is written a decade or two hence, I think we'll find that the shift from mainframes to PCs connected by LANs and WANs was both less traumatic and less expensive than it seems as we look ahead from 1993's perspective. □

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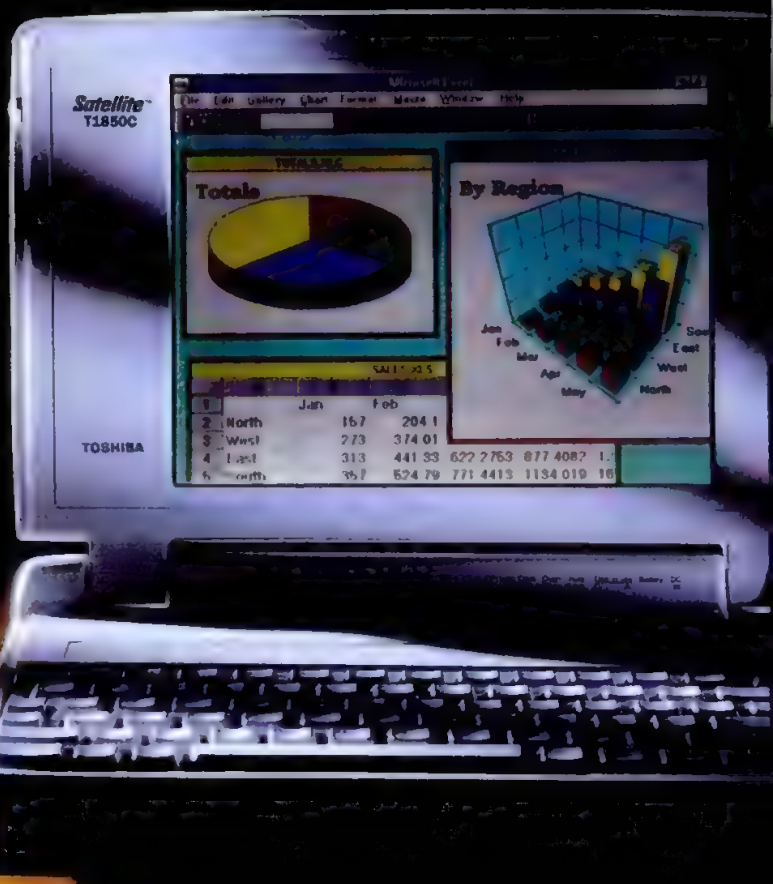

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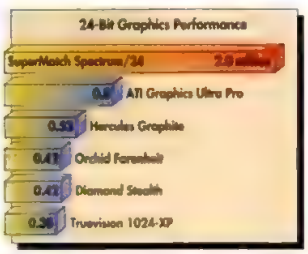

Note: Tests based on the PhotoStones™ 24-bit graphics benchmark performed by Jon Peddie Associates on a 33 MHz 80486-based EISA system. All units are in millions of pixels/second.

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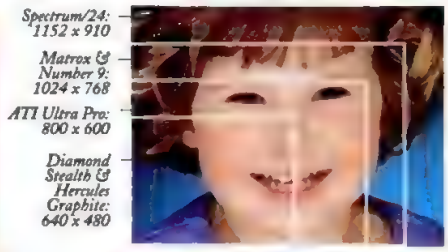

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Bill Howard

The Naked Pen

Pen computing still fails the Emperor's New Clothes Test. Meaning: Normal people—as opposed to industry insiders—don't see much sense in paying $3,000 for a slow, fragile, 5-pound computing pad that can barely read block handwriting. They see all too clearly what many of us have missed: The tablet has no clothes.

Pen computing has a great future. But it's definitely the future. In nearly every area that counts, pen technology is still evolving. System weight and size, battery life, CPU horsepower, wireless communications, applications, and handwriting recognition are all immature.

Still, there are reasons to consider pen computers even today. You may want to acquire a handful this year for pilot projects in your company that could evolve into full-blown tablet deployment next year. Forms has the greatest near-term potential because even the worst recognizer can figure out what an X or a check mark means in an on-screen form. Here's what you should expect in a pen computer that's worth buying:

First, the system needs to weigh about 3 pounds. Reflective technology is a loser on large-screen tablets (handheld PDAs may be an exception), so you need backlighting. The battery needs to deliver 3 to 4 hours of continuous-on power, giving you a full 8-hour workday in stop-and-go computing mode. You don't want an internal floppy disk because of the bulk and weight. But you do want a companion keyboard for typing notes longer than two or three sentences.

You need 486-class power. Pen software is a performance pig. To turn the on-screen page from today's appointments to tomorrow's takes 3 to 5 long seconds on a 386.

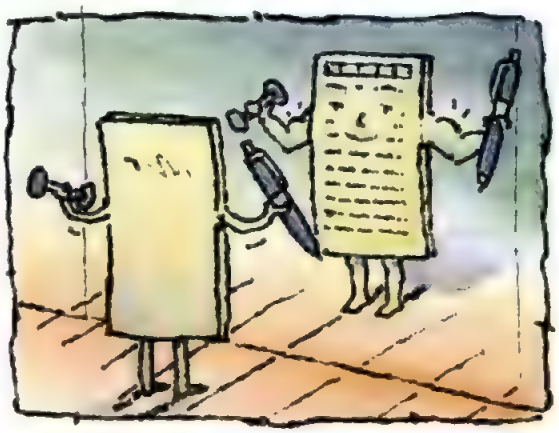
Pen portables beg for wireless communications. Short-range in-building devices that can hook up to LANs are already available for less than $500. Long-haul devices, other than data paging receivers, still have a ways to go.

If you want to place bets on pen and tablet technology, here are three good ones:

Pens on the desktop. Pens don't have to be used only on portables. Pens make great desktop mouse replacements. With the pen you can lasso a block of text faster than you can click and drag with a mouse; then you use simple gestures to move the text (draw an arrow from the marked block to the place where it's supposed to go) or delete it (either an X or the pigtail curlicue used by editors). You can invoke dozens of common functions with a tap of the stylus.

Hybrid tablet/notebook portables with integral keyboards. The unspoken premise behind the GRiD Convertible (whose tablet slides on hinges to reveal a keyboard) is that if your pilot project doesn't work out, you've still got a highly functional 5-pound notebook. Unfortunately, with its 386SL/25 CPU, you're almost guaranteed the pen computing half won't work out.

PDAs as PC workalongs, not replacements. PDAs complement, rather than replace, notebook and desktop systems. They're rugged because of their small size. (The smaller the LCD panel, the less likely it is to break.) Battery life will be great because the screen isn't likely to be lit; if it is, there's less area to illuminate. While you've heard of $1,000 PDAs such as Apple's Newton, the market may warm up more quickly to sub-$300 products built for specific purposes—such as a device that only stores names and phone numbers and that lets you jot down a few notes. Don't think of the PDA as the natural enemy of the PC (the way mainframers came to think of the PC). Rather, PDAs extend the reach of personal computers. Eventually that data will come back to roost in traditional PCs on the desktop. □



Like the emperor in the old fairy tale, pen computing still needs a whole new wardrobe.

Illustration by Daniel Baxter

NETWORKING FOR THOSE TRYING TO RUN A BUSINESS. NOT A COMPUTER.

If you're a Windows user, Windows for Workgroups is the easiest way to network. If you're not using Windows, it's one of the best reasons to start.

No matter what business you're in, you stand to do a lot more of it when all your PCs are working together. And Microsoft® Windows™ for Workgroups is the easiest way to connect them.

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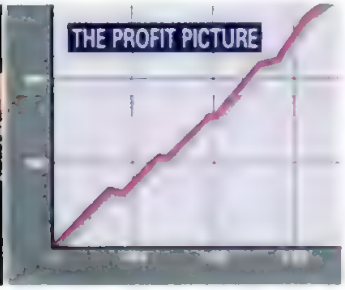

Left: Windows for Workgroups makes it easy for groups to share files and information. Right: Which makes it much easier for you to show a profit.

We could tell you how well Windows for Workgroups works. But it might be more convincing if you heard it from someone like you, who doesn't have a lot of time to spend running computers.

Crest Oelke at Dairy Queen of Greater St. Louis decided on Windows for Workgroups after watching 4 of his employees try to manage the accounting for 3 operations. Now they don't have to enter the same inventory, payable and receivable data into several PCs. Instead, they enter it once into their accounting package and it's a done deal, making everyone's life a lot easier.

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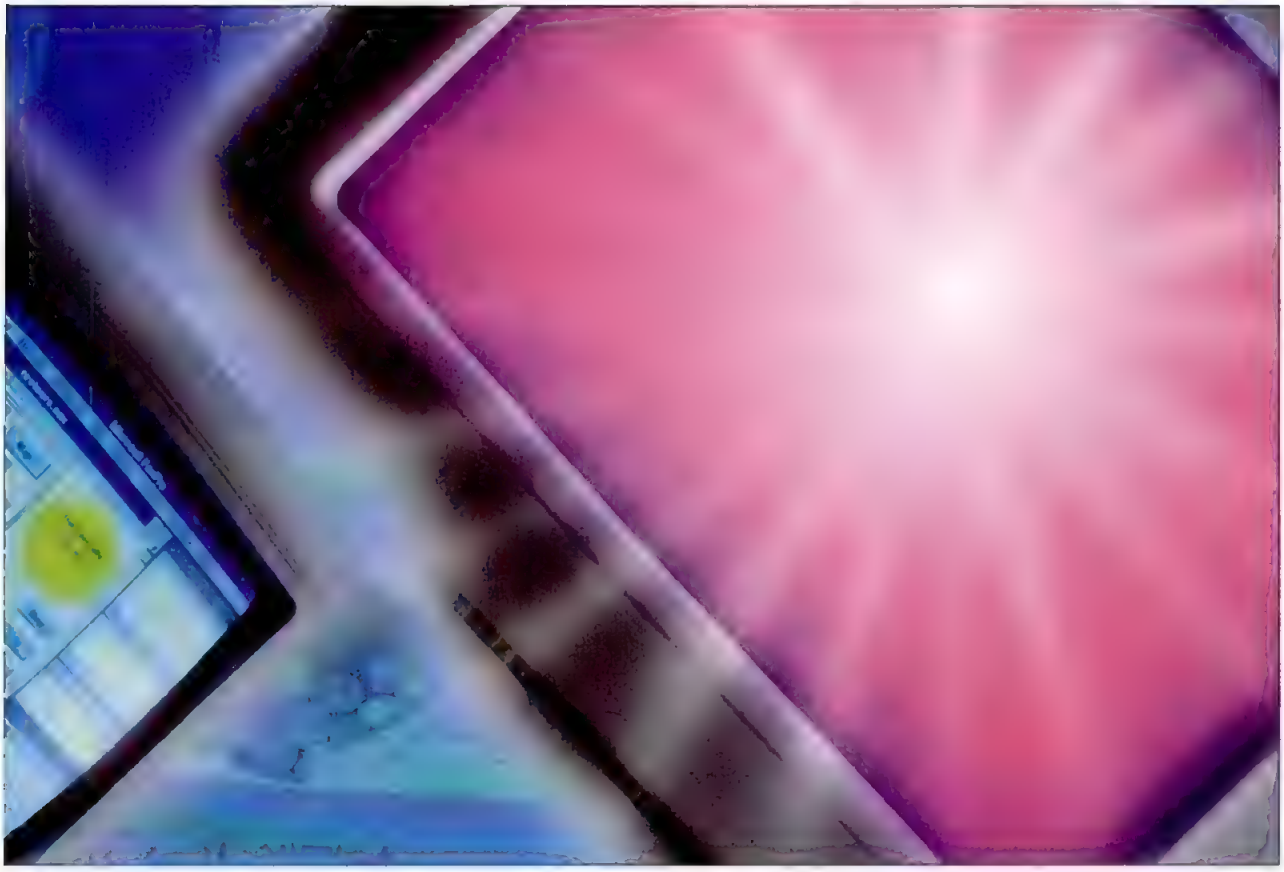
RELATIONAL DATABASES

New Blood,

With so much activity in the database market lately, it's hard to keep up. Dramatic product acquisitions and the rush to market with new Windows products can leave developers wondering which way to turn. This review of ten relational databases provides some guideposts.

Photography by Chris Gould

New Power



The database arena used to be a pretty dull place, but it's amazing what a little competition can do. The past year has seen a spate of company and product acquisitions. Borland International acquired dBASE, Ashton-Tate Corp.'s venerable standard, and bought Arago from WordTech. Microsoft bought Fox Software. Computer Associates picked up dBFast and acquired Nantucket Software—a move that netted Clipper. In this environment, we've seen a flurry of Windows-based products coming to market, including Microsoft Access, Microsoft FoxPro, and Borland's Paradox for Windows. Vendors are jockeying for position, trying to capitalize on their new acquisitions and rushing to jump on the Windows gravy train.

All this has meant good news for database developers. Vendors have enhanced perfor-

by Dave Browning

IN THIS REVIEW

Advanced Revelation *117*
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mance with new technology, improved user interfaces, and removed barriers between disparate file formats. To help developers get a feel for what's available in this evolving marketplace, we review ten database offerings and preview upcoming releases of three more.

MAKING THE CUT

Our aim for this roundup was to present the relational database tools best suited for developing custom apps in a corporate environment. Intended for professional developers, the databases we reviewed had to offer a programming environment that lets a user build applications with tailored functionality. The packages also had to have interactive end-user tools that developers could use to construct simpler apps quickly and easily without programming.

Products that had not undergone a major revision since we last reviewed them are not revisited here. You can find them in "Nine Multiuser Databases: Robust and Ready to Share" (*PC Magazine*, March 31, 1992) and "Xbase Development Systems: Alive and Better than Ever" (May 26, 1992). New versions of Borland's dBASE IV for DOS and Computer Associates' CA-dBFast, in beta testing at the time of this writing, are previewed in sidebars to the main story. Clarion Software, whose Clarion Database Developer, Version 3.0, was in prerelease as we prepared this story, asked not to be included. Also, because Clipper lacks interactive end-user tools, it is not reviewed here.

Since networking has become such a standard in the corporate environment, we required each product to be a true multiuser database with file locking and concurrency controls. Products such as WindowBase from Software Products International, which support only single users, are not reviewed. Finally, we limited our examination to products with a file/server architecture rather than a client/server architecture.

Multiuser file/server relational databases are the first step up from single-user standalone applications into the world of shared data. In the file/server architecture, all executable portions of the database application run on the client PC; the network file server simply stores the shared data files and provides locking services. When a client PC executes a query, the server sends all potential data to the client, which then discards whatever isn't needed. The client performs data integrity and validity checking, even if the rules are stored on the server.

In the client/server architecture, the database server contains the shared files along with data-integrity and validation rules—and also some "intelligence." The client application contains the menus, forms, report definitions, and program code associated with the user interface. The server performs query processing as specified by the clients and sends only the information resulting from queries back across the network to the client. The client/server approach is more reliable and faster for high-volume data traffic but much more expensive. Client/servers systems are the best choice for mission-critical applications, but file/server systems are a more cost-effective solution for most other business database needs.

THE RELATIONAL HURDLE

The term "relational" has a very specific theoretical definition, but in common us-

Suitability to Task: Relational Databases

More than any other business application, a database system has to be all things to all people. The package should be powerful, flexible, and easy to use for both the developer and end user. Users should also be able to access their data wherever and however it is stored.

For **end-user applications**, we rate each database management system on its flexibility and ease of use for a user performing common interactive operations. Our evaluation included database administration, import and export capabilities, data entry screens, and simple task automation. We also considered each package's implementation of tutorials and the robustness of its sample applications.

SUITABILITY TO TASK

Product Name	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	○	○	○
Professional Development	●	●	○	○
Querying and Reporting	●	●	●	○
Connectivity	●	●	●	●

Professional development indicates how suitable the package is for serious application development. The ease of use of the development environment is important, as is the breadth of programming functionality. Other areas we included in this rating are prototyping the application methods a product offers; and its support for mainstream programming languages, such as C.

For the **querying and reporting** score, we rate the systems on areas that involve database queries and data output. We take into account form generation, query design mechanisms, and report generators for this category. Since the performance of queries relies heavily on the robustness of the database package and its indexing architecture, we considered these areas as well.

We also evaluate each package on its **connectivity** features, which include network support and flexibility when working with other applications and data formats. We took into consideration which import and export formats each package supports, and if each can natively access disparate database formats. We also considered the product's suitability to client/server environments, along with its security mechanisms and its data integrity and concurrency features.

age it describes a system composed of separate files (or *tables*) that together comprise a single database. The separate tables are often in a *one-to-many* relationship; that is, detail records related to one table are stored in another table. So for a small business, you might have a customer table and then an order table that contains detailed information for each customer. The two tables are linked together by a common field; in this example it would be customer number. The relational method of storing data makes efficient use of disk space, since information applying to many records (for example, a customer's name and address) is stored only once.

Normalization, which is the process of organizing database tables so that there is as little duplication of data as possible among all the tables in the database, is crucial to the relational model. It's easy to normalize a small database that contains only a couple of tables, but things can get much more complex as the database gets larger. How a database should be normalized depends on the meaning attached to the data elements. The normalization process cannot be automated; it requires an experienced database administrator.

Our Contributors: TONY POMPILI is the systems manager at Ziff-Davis Publishing Co. ALFRED POOR and JOE SALEMI are contributing editors to *PC Magazine.*

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STAN LESZYNSKI is the owner of a consulting company specializing in the development of custom database solutions. JONATHAN WALDMAN heads Dialog Software, a software engineering and database consulting firm. SHERYL CANTER was the associate editor in charge of this story, and STEPHEN W. PLAIN was the project leader.

PC MAGAZINE

EDITORS' CHOICE

- **Microsoft FoxPro 2.5 for DOS**
- **Microsoft FoxPro 2.5 for Windows**
- **Paradox for Windows**

With the largest software companies now making databases a central part of their businesses, the competition is fierce. The biggest winner of all is the database developer. Relational databases are catching up with other mainstream software products in ease of use, while at the same time becoming more powerful and sophisticated.

Three entries stand out from the crowd and earn our Editors' Choice distinction: Microsoft FoxPro 2.5 for DOS, Microsoft FoxPro 2.5 for Windows, and Paradox for Windows. All three products strike a good balance between accessibility and power, which gives them broad appeal. End users and professional developers will find them useful tools. If you have a legacy of Xbase code or if speed is of primary importance, then you will want to look at one of the FoxPro packages. If you're looking to start a new database, one guaranteed to take advantage of today's new OOP tools, then Paradox is a natural.

FoxPro was always fast, but now it's even faster. The DOS and Microsoft Windows versions blazed through our performance tests. FoxPro also provides strong end-user tools. Its screen builder lets even novices pull a database application together quickly. The Windows version maintains the powerful but friendly tradition of the DOS product, while taking good advantage of special Windows features such as DDE and OLE. Its cross-platform transporter lets you easily move applications between DOS and Windows, and the new conditional compilation capability lets developers maintain a single code base for both DOS and Windows versions of their application.

Paradox doesn't have the speed of FoxPro, but it brings relational databases to a whole new level of sophistication by combining a consistently object-oriented interface, referential integrity, and transparent access to multiple file formats. With the inevitable engine tuning in future versions, Paradox will become even stronger.

Other products we reviewed are less broad in appeal but noteworthy. Superbase takes good advantage of the Windows interface and is wonderfully easy to use, though we found it lacks the horsepower to hold up in a high-volume, multiuser environment. DataEase adeptly combines a powerful application builder with ease of use, but again at the expense of speed.

If a steep learning curve is a viable tradeoff for power and flexibility, Advanced Revelation or KnowledgeMan might suit your tastes. But be prepared: These high-end development tools don't coddle nonprogrammers.

R:BASE also merits special mention here. Though the current version lacks some of the bells and whistles offered by its competitors, R:BASE more closely adheres to the classic relational model than do the others. That fact, along with its solid SQL and excellent data integrity and rule-validation features, make it a favorite among hardcore database developers.

Finally, whether you're upgrading or building a system from the ground up, there are plenty of reasons to look at the old standard, dBASE. Released as we went to press, dBASE IV 2.0 offers something that previous versions never did: speed. In fact, this beta package was a top performer on our preliminary tests. Borland has made dBASE easier to use, enhanced the programming language, and launched the much-awaited dBASE compiler.

When a database is composed of multiple related tables, developers must be careful to maintain *referential integrity*—that is, internal consistency such that no record refers to other records that no longer exist. For each *child record* (the customer orders in our example), there must be a *parent record* (the customer record with which the order records are associated). Of the databases in this story, Advanced Revelation, DataEase, Paradox for DOS, Paradox for Windows, R:BASE, and Superbase provide referential integrity at the engine level.

THE SQL CONNECTION

Many of the databases in this review use some variant of SQL (Structured Query Language) for data access and manipulation, since that language was designed for use with relational data. But SQL is not a general-purpose programming language, so all databases packages provide some other programming language for use in conjunction with—or instead of—SQL. SQL is most often used to request data from the file server. But you don't need to learn SQL syntax to use SQL. Query by example (QBE) is a visually oriented method of specifying queries where conditions are given within a table-like grid.

SPEED CONSIDERATIONS

Querying—the process of retrieving data in a way that meets a specified set of conditions—is the most frequent operation in database applications. A lot of attention is placed on query speed by vendors and purchasers alike. Much research and development effort is applied to *query optimization*, the technique of analyzing a query request and determining the fastest way to satisfy it: when to use indexes, when to search a table sequentially, and so on. Query optimization is a complex technology, part science and part art, but the results can make or break database performance.

Access techniques can also have a big impact on the speed (or apparent speed) of a database. This created some challenges in our testing: How do you define when a query is complete? If you are an end-user waiting at your screen for the results of a query, you may think the query is done when you see the first screenful of results. Some databases make you wait until all of the specified records are found before showing any of them to you; others, such as dBASE, process the query until a screenful of data has been found, present it to you, then wait until you scroll down before continuing the selection. Still others, such as Access, present the first screenful and continue finding the rest while you are reviewing the first part of the results. To make sure we measured the same task in each case, we defined search completion as when the last selected record is available to you. But be aware that the apparent speed of a query may be faster than our test results suggest, depending on the product's retrieval technique.

Query optimization is a complex technology, part science and part art, but the results can make or break database performance.

Another factor that affects speed is the format of the query result set. Some database products save the requested information in a result table stored on disk; others create a snapshot table for the records in memory. Still others, like FoxPro, retrieve only the record numbers for large result sets and then perform a second step to access the actual identified records. This technique appears to work to FoxPro's advantage. On our Random Read test, both FoxPro for DOS and FoxPro for Windows boasted impressive scores, even as network traffic ballooned.

Some of the packages we reviewed, including Access and Paradox for Windows, let you directly manipulate files in foreign formats; you do not have to import the file into the product's native format in order to use it within an application. Access implements Microsoft's Open Database Connectivity (ODBC) technology to accomplish this, while Paradox for Windows uses Borland's Open Database Application Programming Interface (ODAPI). These APIs (application programming interfaces) offer competing standards for talking to databases of all kinds. The ability to do this is good news for developers trying to integrate data from multiple sources, but there is usually a speed penalty for the convenience. We used only the product's native database format during our performance testing.

HOW MUCH PROGRAMMING?

Though every product reviewed here is powerful enough to develop most applications needed for business purposes, they vary widely in the burden they place on developers. Some, like Advanced Revelation and KnowledgeMan, are oriented primarily toward programmers and offer limited end-user tools. Other packages, such as Access, DataEase, and Superbase, help novices get started quickly with a friendly interface, code generators, and an easy-to-learn language. Unfortunately, there is almost always a trade-off between how easy a product is to learn and its flexibility and power as a development tool. Most products fall in the middle, providing significant access to features through menu options but requiring programming to access the package's full power.

Still, the advent of the graphical user interface in the database world has made everything easier. The Windows-hosted packages in this roundup—Access, FoxPro for Windows, Paradox for Windows, Superbase, and dBFast—let developers build graphical applications replete with menu bars, radio buttons, and pick lists simply by dragging and dropping and pointing and clicking. Paradox for Windows takes usability a step further with its object-oriented development environment. Every element in Paradox for Windows is a reusable, easily customizable object—including queries, result sets, and interface elements.

As a group, the Windows databases were significantly slower on our tests than the DOS products. However, FoxPro for Windows, whose speed surpassed almost every other product in this roundup, proves that Windows databases do not have to be slow. Only three of the products in our review support versions for OS/2: Advanced Revelation, KnowledgeMan, and R:BASE. But none

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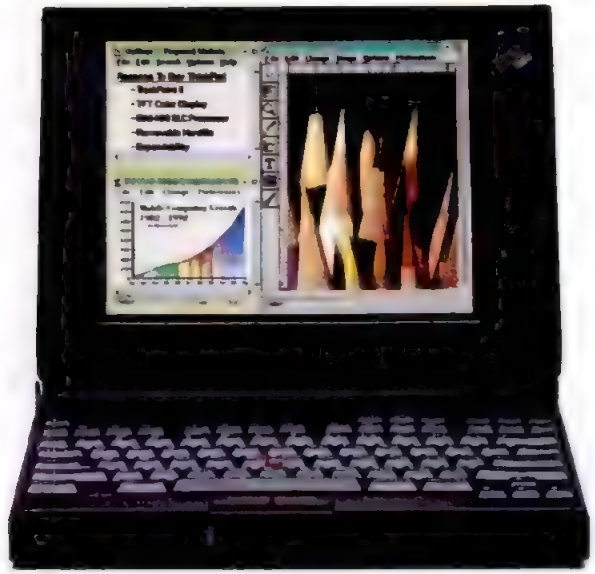

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***Screen at right depicts OS/2, also available pre-installed on this model.
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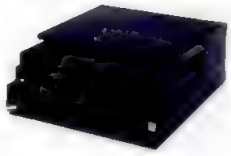

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Revelation Technologies Inc.

Advanced Revelation

BY JONATHAN WALDMAN

Version 3.01 of Advanced Revelation may not be the fastest database system you can buy, but it's probably the most adaptable. Because this is a professional-level package, you'll need to learn Advanced Revelation's powerful BASIC-like programming language to tap into its more advanced features. And Advanced Revelation is costly: A single-user version lists for $1,195, and there are additional charges for network licenses and technical support.

Advanced Revelation's most distinguishing characteristic is the way it stores and retrieves data. All data is stored as variable-length strings, regardless of the data type; Advanced Revelation relies on data dictionaries to interpret the columns of information in each table. The product also employs multivalue fields, which allow a variable number of items to be stored in a single field; this in effect creates a one-to-many relationship at the column level. Finally, Advanced Revelation uses a proprietary linear-hash filing system. Linear-hash files are self-sizing (they expand or contract automatically as data is added or deleted) and self-optimizing (access to data is always as efficient as possible). These files represent the best balance between speedy access to data and minimum cost in disk space.

Advanced Revelation's QBE capability takes you step-by-step through the process by providing helpful pop-ups and windows.

IMPORTANT IMPROVEMENTS

Version 3.01 contains some noteworthy improvements over previous versions. The user interface has been redesigned, making it more (but not quite completely) compliant with the latest CUA (Common User Access) standard. The menu system is very complex, because of the huge number of choices Advanced Revelation offers. Eventually, most users will find themselves entering commands directly into the command level (TCL) so that working through menus becomes unnecessary.

The documentation has been totally redesigned and is now published in perfect-bound manuals. Large parts of it have been rewritten and offer excellent explanations, peppered with useful examples, of Advanced Revelation's architecture and daunting array of features. There is also an improved interactive tutorial in which a working inventory application is created. On-line help, as in earlier releases, is plentiful.

Other improvements in this release include more standard nomenclature throughout, improved indexing speed, and some new features in Paint—the data-entry screen designer.

SPECIAL FEATURES

With Advanced Revelation's MFS (modified filing system) hooks, you can intercept any file-oriented process, such as reading, changing, or deleting information. You can, in fact, replace the entire filing and indexing systems if desired. Most developers design MFSs for relational integrity and security purposes, and a variety of third-party MFSs are available.

Another uncommon feature is Advanced Revelation's support for transaction processing that ensures that several changes to files occur either all at once or not at all. This feature protects the integrity of a database against power outages and network contention. When transaction processing is on, transactions are written to a temporary table. You can then use the TCL commands TRANSACTION COMMIT, TRANSACTION ROLLBACK, or TRANSACTION RESTART. When you commit the transaction, data in the temporary table is copied to actual data tables. Even if something goes awry during the commit process, you can always restart the transaction. To assist the developer, the

SUITABILITY TO TASK

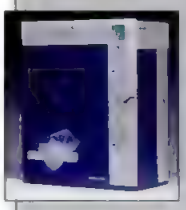
Advanced Revelation

	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	●	○
Professional development	●	●	●	●
Querying and reporting	●	●	●	○
Connectivity	●	●	●	●

FACT FILE

Advanced Revelation, Version 3.01

Revelation Technologies Inc., 181 Harbor Dr., Stamford, CT 06902; 203-973-1000; fax. 203-975-8735



List price: $1,195, five-user LANPack, $995

Requires: 286-based PC or better, 7MB hard disk space, DOS 2.0 or later

In short: Version 3.01 of Advanced Revelation is a flexible and feature-rich database package designed for professional database developers. Be warned, though: You will need to learn Advanced Revelation's powerful programming language to access the package's most advanced functions. Special features include variable-length records, multivalue fields, data dictionaries, and a proprietary linear-hash filing system. This package is best suited for large-scale networked applications.

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▶ SUMMARY OF FEATURES

Relational Databases

Products listed in alphabetical order

■ = YES □ = NO

	Advanced Revelation	DataEase	KnowledgeMan	Microsoft Access	Microsoft FoxPro for DOS (PC Editors' Choice)	Microsoft FoxPro for Windows (PC Editors' Choice)	Paradox for DOS
List price	$1,195	$795	$1,495	$495	$495	$495	$795
Operating environment	DOS	DOS	DOS	Windows	DOS	Windows	DOS
Other versions available	Windows, OS/2	Windows, OS/2	OS/2, Unix, VMS	None	Macintosh and Unix ("FoxBASE+"), Windows	Macintosh and Unix ("FoxBASE+"), DOS	Windows, OS/2
Expanded memory support	■	■	■	□	■	□	■
Extended memory support	□	■	■	■	■	■	■
Minimum required	N/A	3MB	No minimum	2MB	No minimum	3MB	0.5MB
Data Manipulation Limits							
Maximum column/field size	64K	255 characters	64K	32K	256 characters	256 characters	255 characters
Maximum row/record size	64K	4K	64K	Unlimited	64K	64K	4K
Maximum number of:							
Fields per record	600	255	255	255	255	255	255
Indexed fields per record	Unlimited	255	255	32	255	255	255
Records per table or file	Unlimited	16 million	2 billion	Unlimited	1 million	1 million	255MB
Tables or files per database	Unlimited	2,000	Unlimited	32,768	Unlimited	Unlimited	Unlimited
Indexes per database	Unlimited	508,000	Unlimited	1 million	Unlimited	Unlimited	Unlimited
Open tables or files	Unlimited	60	240	254	255	255	Unlimited
Views per database	N/A	2,000	N/A	32,768	Unlimited	Unlimited	Unlimited
Tables per view	N/A	1	N/A	16	255	255	9
Joined tables	Unlimited	255	None	350	224	224	24
Data Types and Limits							
Arrays:							
Dimensioned	■	□	■	□	■	■	■
Variable-length	■	□	□	□	■	■	■
Fixed-character	■	■	■	■	■	■	■
Variable-character	■	□	□	■	■	■	■
Integer	■	■	■	■	■	■	■
Fixed-decimal	■	■	□	■	□	□	□
Floating-point decimal	■	■	■	■	■	■	■
Date	■	■	□	■	■	■	■
Time	■	■	□	■	□	□	□
Boolean	■	■	■	■	■	■	■
Virtual (calculated)	■	■	■	■	□	□	■
Indexing							
Automatic indexing	■	■	□	■	■	■	■
Can be turned on and off	■	□	N/A	□	■	■	□
Composite field indexes	■	■	■	■	■	■	■
User can index key	■	■	■	□	■	■	□
Definable exclusion list	■	□	□	□	■	■	□
Supports uniques	■	■	□	■	■	■	■
Indexes and access methods supported:							
B-tree	■	■	■	■	■	■	□
Clustered B-tree	□	□	□	□	□	□	□
Hashed	■	□	□	□	□	□	■
Data Definition/Integrity							
Data dictionary	■	□	■	■	□	□	□
File catalog	■	■	□	■	□	□	□
Data validation:							
Data-type enforcement	■	■	■	■	■	■	■
Specific match	■	■	□	■	■	■	■

N/A—Not applicable: The product does not have this feature

CONTINUES

	Paradox for Windows	R:BASE	Superbase
	$795	$795	$795
	Windows	DOS	Windows
	DOS, OS/2	OS/2	None
	■	■	■
	■	■	■
	3.5MB	2.5MB	1.3MB
	255 characters	4K	4K
	4K	4K	Unlimited
	255	400	Unlimited
	255	400	999
	256MB	Unlimited	16 million
	Unlimited	1,000	Unlimited
	Unlimited	2,000	Unlimited
	Unlimited	16,000	Unlimited
	Unlimited	1,000	Unlimited
	9	Unlimited	Unlimited
	24	Unlimited	Unlimited
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	■	■	■

package provides a "commit.log" detailing pending transactions. This log is a queue, so you can manage pending transactions by deleting or reordering them.

"Environmental bonds" enable Advanced Revelation to directly access and change data stored in different formats. Using bonds, you can store fixed-length data in a SQL table and variable-length information such as text in Advanced Revelation's native format, and then join them, making good use of both technologies. Advanced Revelation includes bonds for both ASCII and dBASE III; other bonds are available for an additional charge. Only ASCII, dBASE III/III+, and Lotus 1-2-3 files can be imported or exported without additional programming.

Advanced Revelation's "logical locks" helped it on certain tests, where it showed no apparent throughput degradation as we added workstations.

IMAGINE: NO LIMITS

Advanced Revelation imposes no restrictions on the developer; if you don't like something, you can change it. The product's R/BASIC language is powerful, offering roughly 160 commands. The TCL interface offers about 80 more commands for performing more general operations, such as ad hoc report or management functions. TCL can make use of any R/BASIC routine, and vice versa. When these are not enough, R/BASIC can be extended by calling routines written in either assembler or C, but this requires purchasing special software from the company.

The Code and Command feature also launches specialized routines. It accesses indexes, runs TCL commands or R/BASIC programs, and displays pop-ups, windows, menus, messages, and help. You can use Code and Commands from within R/BASIC programs and when defining windows, forms, menus, macros, applications, and users.

There are a plethora of tools available for conducting queries and generating reports. QBE is available with a point-and-click interface. Query by form is supported from any data entry window.

There is a command line interface to SQL, plus something called SQL-Assistant—a series of pop-up windows designed to guide you through the SQL statement creation process. It's easy to define queries across multiple tables by using SQL's dot operator, and Advanced Revelation's bonds allow tables from other environments to be included transparently. The SQL data querying ability is almost ANSI 2.0–compliant (it lacks GRANT/REVOKE functions) and is implemented impressively. Alternatives to SQL are pure R/BASIC code and Revelation's R/LIST language, EasyWriter. EasyWriter is a pop-up–driven "front end" to R/LIST very much like the SQL-Assistant. Any R/LIST or SQL statement can be translated into R/BASIC source code, which can then be tailored.

The powerful browse facilities make it easy to page forward and backward through data from an active select list. Browse lists can be altered on the fly by either adding or deleting records in the list, and they can be saved for future use.

MEASURING PERFORMANCE

Advanced Revelation is designed to perform best on large networked applications, but the normalization strategies used in other databases do not necessarily apply to Advanced Revelation because of its multivalue fields. Because our performance tests are designed for use with normalized tables, Advanced Revelation's performance suffered on certain tests.

One of Advanced Revelation's strengths proves to be a weakness where speed is concerned. The native linear-hash filing system makes variable-length records and automatic file resizing possible, which saves disk space. But while the overhead involved is less noticeable for record reads, it is quite apparent during record writes. Our Update and Random Write tests brought out the performance degradation due to the linear hash.

Unfortunately, Advanced Revelation

SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Advanced Revelation	DataEase	KnowledgeMan	Microsoft Access	Microsoft FoxPro for DOS (PC Editors' Choice)	Microsoft FoxPro for Windows (PC Editors' Choice)	Paradox for DOS
Data Definition/Integrity (continued)							
Pattern match	■	■	□	■	□	□	■
Data ranges	■	■	□	■	■	■	■
Table lookups	■	■	□	■	■	■	■
Rule-based	■	■	□	□	□	□	□
Soundex	□	■	□	□	■	■	□
User-definable	■	□	■	■	■	■	□
Requires primary key	■	□	□	□	□	□	□
Supports composite key	■	□	■	■	■	■	■
Unique value enforcement	■	■	□	■	■	■	■
Referential integrity:							
Cascade	■	■	□	□	□	□	■ (updates only)
Restrict	■	■	□	■	□	□	□
Nullify	■	■	□	□	□	□	□
Query Facilities							
Query language:							
dBASE-compatible	■	■	□	□	■	■	□
SQL-compatible	■	□*	□	■	■	■	□*
Proprietary	■	■	■	□	□	□	■
Query interface:							
Command line	■	■	■	■	■	■	□
Menu-driven	■	■	■	□	■	■	□
Query by form	■	■	□	□	□	□	□
Query by example	■	■	■	■	■	■	■
Includes precompiler/optimizer	□	□	■	■	■	■	■
Recursive (nested) select	■	■	□	□	■	■	■
Maximum number of search fields	Unlimited	255	Unlimited	255	Unlimited	Unlimited	255
Sorting:							
User can sort on any field	■	■	■	■	■	■	■
User can sort on multiple fields	■	■	■	■	■	■	■
Stored queries	■	■	■	■	■	■	■
Relational operators:							
Difference (MINUS)	□	■	□	□	■	■	■
Divide (DIVIDEBY)	□	■	□	□	□	□	■
Intersect	□	■	■	■	■	■	■
Join	□	■	■	■	■	■	■
Natural	N/A	■	■	■	■	■	■
Outer	N/A	■	□	■	□	□	■
Project	□	■	■	■	■	■	□
Product (TIMES)	□	■	□	■	■	■	■
Select (WHERE)	■	■	■	■	■	■	■
Union	□	■	■	□	■	■	■
Database Language Features							
Language type:							
Compiled	■	□	■	■	■	■	□
Interpreted	■	■	■	■	□	□	■
Supports embedded SQL	■	■	■	■	■	■	□
Macro capabilities:							
Automatic recording	■	□	□	□	■	■	■
Keystroke memory macros	■	□	■	■	■	■	■
Macro language	■	□	□	■	■	■	□

N/A—Not applicable: The product does not have this feature * This feature is available in a different version of the package

CONTINUES

Paradox for Windows (PC Editors' Choice)	R:BASE	Superbase
■	■	■
■	■	■
■	■	■
■	■	■
□	■	■
□	■	■
□	□	□
■	■	■
■	■	■
■ (updates only)	■	■
■	■	□
■	□	□
■	□	□
□*	■	□*
■	□	■
□	■	■
□	■	■
□	□	□
■	■	■
■	■	□
■	■	□
255	50	Unlimited
■	■	■
■	■	■
■	■	■
■	■	□
■	□	■
■	■	■
■	■	■
■	■	■
■	■	■
□	■	■
■	□	■
■	■	■
■	■	■
■	□	□
□	■	■
□	■	□
□	■	■
□	■	■
□	■	■

could not successfully import 100,000 rows from the ASCII files supplied by PC Magazine Labs, so we report its Load and Index test results as "fail." The product's manufacturer has since corrected these import problems in Version 3.02, a maintenance release.

With the exception of Superbase, Version 2.0, Advanced Revelation was the only database that showed no apparent throughput degradation as we added more workstations during the Random Write test. Additionaly, along with several other products tested, it also showed no apparent throughput degradation as we added more workstations during the Random Read test.

Advanced Revelation performed well in these areas because it maintains record locks by using tokens, so the actual data is never physically locked. Such "logical locks" are advantageous, since more than one record often resides in a single linear-hash group, and several workstations can access information contained in that group.

Technical support for Advanced Revelation, which is excellent, is free for the first 90 days but becomes expensive afterward. There are three support categories: Bronze ($400 per year), Silver ($1,295 per year), and Gold ($5,000 per year).

Advanced Revelation is an exceptional high-end programmable database that offers much power and flexibility, but it has a very steep learning curve and is quite expensive. Advanced Revelation is best suited for networked applications using variable-length data, such as human resource, legal, library, and museum applications. If your applications will operate mostly on fixed-length data, consider another product, since Advanced Revelation's linear-hash filing system would be useless overhead.

DataEase International Inc.

DataEase

BY TONY POMPILI

DataEase International's DataEase, Version 4.53, gives the novice developer a simple, menu-driven interface while providing the expert with a flexible development environment. It's not the fastest system available, but DataEase is a solid, reliable product that is powerful enough for most applications.

Priced at $795, DataEase comes with the usual entourage: a report generator, QBE capabilities, and the DataEase Query Language (DQL) for application development. An optional $495 add-in, DataEase SQL Connect, lets you develop applications that work with Sybase SQL Server, Oracle Server, and IBM's OS/2 EE Database Manager and DB2.

WELL-DESIGNED INTERFACE

A key component of DataEase is its menu-driven, tour-guide–like interface. Field-dependent menus are displayed across the top of the screen, and a status line across the bottom indicates the current assignment of the function keys. Moving the cursor from field to field produces a new menu of choices for that field. Optional mouse support gives you point-and-click access to menu items and function-key commands.

In addition to the full menu system, DataEase uses dialog boxes extensively to lead developers through more complex procedures. For example, when creating joins among databases, a

FACT FILE

DataEase, Version 4.53
DataEase International Inc., Seven Cambridge Dr., Trumbull, CT 06611; 800-243-5123, 203-374-8000

List price: Single-user version, $795, five-user version, $1,095
Requires: 286-based PC or better, DOS 3.3 or later, or OS/2 1.3 or later. Mouse recommended
In short: DataEase, Version 4.53, has a menu-guided system that can lead even the most inexperienced user through database development. You can accomplish virtually every creation and administration task through the use of menus, which makes DataEase ideal if you need to get a database system up and running quickly. More experienced developers will appreciate Version 4.0's new custom-defined–function capability for extending the features of the development environment. While not the swiftest database manager you can purchase, DataEase is a solid product that can meet most of your needs.

478 ON READER SERVICE CARD

SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Advanced Revelation	DataEase	KnowledgeMan	Microsoft Access	Microsoft FoxPro for DOS (PC Editors' Choice)	Microsoft FoxPro for Windows (PC Editors' Choice)	Paradox for DOS
Security Features							
Application encryption	■	■	■	■	■	■	□
Data encryption	■	■	■	■	□	□	■
Password protection and restricted access levels:							
Database	■	■	■	■	□	□	□
Dictionary	■	□	□	■	N/A	N/A	□
Field	■	□	■	■	□	□	□
Record	■	□	□	■	□	□	□
Table	■	■	■	■	□	□	■
User	■	■	■	■	□	□	□
Restricted commands	■	□	□	□	□	□	□
User-specific interface	■	□	□	■	□	□	□
Multiuser Support							
Lock types:							
Coordinated	■	□	□	□	□	□	■
Exclusive	■	■	■	■	■	■	■
Shared	■	■	■	■	■	■	■
Lock granularity:							
Database lock	□	■	■	■	■	■	□
File lock	■	■	■	■	■	■	■
Record lock	■	■	■	■	■	■	■
Field lock	□	□	□	□	■	■	□
Identifies station with lock	■	■	□	■	□	□	■
Locks indexes	■	■	■	■	■	■	■
Update refresh	□	■	■	■	■	■	■
Isolation control	□	□	□	□	□	□	□
Time-out/retry control	■	■	■	■	■	■	■
Transaction processing:							
Transaction definition	■	■	□	■	□	□	□
Commit/Rollback	■	■	□	■	□	□	□
Two-phase commit	□	■	□	□	□	□	■
Implicit locking	■	■	□	■	□	□	■
Networks supported:							
NetWare	■	■	■	■	■	■	■
Microsoft LAN Manager	■	■	■	■	■	■	■
VINES	■	■	■	■	■	■	■
Unix	□	□	■	□	□	□	□
Import/Export							
Standard file formats:							
Fixed-length ASCII	■	■	■	■	□	□	□
Comma-delimited ASCII	■	■	■	■	■	■	■
.DBF/.DIF	■□	■■	■■	■□	■■	■■	■■
.PFS/.SDF	□□	□□	□■	□□	□■	□■	■□
.WK1/.WKQ	■□	■□	■□	■□	■□	■□	■■
.XLS/SYLK	□□	□□	□■	■□	■■	■■	■■
User-defined formats	■	■	□	■	□	□	□
Applications Development Tools							
Menu generator	■	■	□	■	■	■	■
Report generator	■	■	■	■	■	■	■
Applications generator	□	□	■	□	■	■	■
Runtime version	■	□	■	□	■	■	□*

N/A—Not applicable: The product does not have this feature * This feature is available in a different version of the package

ENDS		
PC EDITORS' CHOICE Paradox for Windows	R:BASE	Superbase
□	■	■
■	□	□
□	■	N/A
□	■	N/A
□	■	□
□	□	□
■	■	■
□	■	■
□	□	■
□	□	■
■	■	■
■	■	■
■	■	■
□	■	N/A
■	■	■
■	■	■
□	□	□
■	■	■
■	■	■
■	■	■
□	■	■
■	■	■
□	■	□
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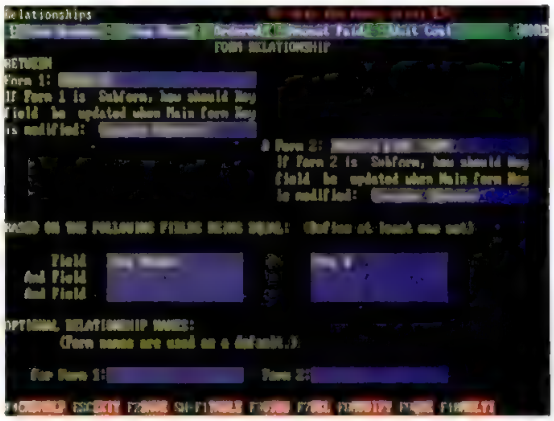
■	■	■
■	■	■
□	□	□
■	■	■
■	■	■
■□	■■	■■
□□	■□	□■
■■	■□	■□
■□	□■	■□
□	□	□
□	■	■
■	■	■
■	■	■
□	■	□

Relationship dialog box pops up with clearly labeled fields, along with prompts asking for the table and field names to be joined.

Even DQL programming, with its 150 available functions and operators, is menu-driven. DataEase guides the user through building the code, helpfully displaying operator options on the prompt line. When you select the number preceding the suggested operator, or select it directly with the mouse, the operator is added to the procedure.



The Relationship dialog box in DataEase makes even complex table joins an easy task.

DataEase's installation disks include distinct versions for 286 and 386 machines running DOS; OS/2 is supported with a third included version. We used the DOS 386 version, DE16M, for testing. The program occupies only about 3MB of hard disk space, and this includes a simple 53K tutorial. For Microsoft Windows users, the packages comes with a predefined .PIF.

SUITABILITY TO TASK

DataEase	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	●	○
Professional development	●	●	●	○
Querying and reporting	●	●	●	○
Connectivity	●	●	●	○

Network installation (the five-user network version lists for $1,095) has one workstation quirk that can be an administrative nightmare. A unique environment variable, DName, has to be set up for each user. Without the variable, DataEase crashes.

CREATING DATABASES

DataEase makes browsing a new database easy. By pressing Shift-F1 while in Record Entry mode, you can instantly see a Browse (or Table) listing of the database you've created. Pressing Shift-F1 again takes you back to the Form view.

DataEase screen (or Forms) development is quite intuitive. When you're creating a field, for example, the program automatically picks up the label and uses it as the field name. The product is even smart enough to remove any trailing delimiters, such as a colon. Unfortunately, the Forms module had a nasty habit of freezing on occasion, forcing you start all over again. The company says that it's working on the problem.

For more complicated joined forms, the DataEase Multiforms feature lets developers create data entry screens that access data in multiple tables. Creating fields is simple, too; dialog boxes let you select field types, lookups for default values, and ranges. You can also create indexes at the same time; you don't need to hop over to an index-creation routine.

Procedures defined with DQL allow developers to automate nearly every DataEase task, including imports, batch updates, queries, and reports. If the 58 functions provided with DataEase don't quite fulfill all your needs, you can create a library of Custom-Defined functions using C, Pascal, or assembler.

The package's QBE feature makes it simple to query one or more tables. A QBE menu steps through each of the basic QBE elements, including the record criteria, sort order, report format, and output. Developers can use DQL at any time during the process to define more complex search criteria. Customized output formats can supersede the default columnar format. You can also use predefined templates, or you can generate reports that resemble your data entry screens.

The backup and restore utilities let you archive entire applications. If you want to reuse forms or reports in another database, the installation utility will ex-

port specific application components and import them into target applications.

DATABASE ADMINISTRATION

Database and user administration, like everything else, is menu-driven. System administrators can easily define passwords, default-screen attributes, and start-up menus. Security can be applied at the database level as well as the field level. There are seven security levels to choose from.

Database administrators are given the option of presenting users with a menu that contains a list of database applications. Unfortunately, when users exit an application, they're dropped to the DOS prompt rather than to the menu. This is inconvenient if users need to switch frequently between databases.

With DataEase, developers can let multiple users view a record, but allow only one to write to it.

For developers of network applications, DataEase provides record-level locking, which can be defined through the Multi-User form options or through a procedure. When locking is controlled by the form, users have the option of automatically refreshing the current record. The Multi-User options provide finer control; developers can let multiple users view a record, but allow only one to write to it.

Despite its record-level locking, DataEase did not perform well on our tests. But though its average throughput during the Random Read test placed it with the slower products, individual workstation throughput remained consistent at about 10 transactions per second, even when handling 36 workstations.

DataEase comes with six months of free telephone support. The documentation includes a master index that makes it easy to find specific features and commands. The on-line help, however, was often not thorough enough to be useful.

While it's not the swiftest product, DataEase is an easy-to-use tool with enough power for most tasks. Its menu-driven architecture makes it especially accessible to less experienced users. If you need to get up and running fast, and speed is not a driving issue, DataEase is a good choice.

Micro Data Base Systems Inc.

KnowledgeMan

BY RICK KNOBLAUGH

If you aren't afraid to write code, and you're also looking for a powerful, extensible development vehicle that is available on multiple platforms, Version 3.1 of KnowledgeMan is a good choice. Micro Data Base Systems sells the single-user version for a pricey $1,495, but the server version is priced reasonably. Whereas the cost of most server databases increases as you add more users to the system, the server version of KnowledgeMan costs $2,995—no matter how many users you want to add.

INTEGRATED MODULES

With KnowledgeMan, you get more than just a database manager. The company provides several integrated modules, including a simple spreadsheet, business graphics, a plain-English interface, text processing, and asynchronous communications. These modules are seamlessly integrated and let you "do anything from anywhere." A spreadsheet-cell "formula" can invoke a KnowledgeMan procedure to interrogate a database and then place the resulting value into a cell in a spreadsheet. With the text processor, you can embed SQL commands inside a document, thereby facilitating the inclusion of queried values as the document prints.

The graphics module supports area, bar, free-form, function, high-low-close, line, pie, and scatter graphs. To graph data from a table, you must first load it into spreadsheet cells or into an array in memory.

The interface module, CHAT, allows less experienced users to perform database queries by using English phrases. Over 300 English words are initially recognized, and you can create your own dictionaries as you need them.

Another one of KnowledgeMan's strengths is its support for multiple platforms. Versions are available for DOS, OS/2, Unix, and VMS. There is broad network support, including NetWare, Microsoft LAN Manager, IBM's PC LAN, and any other LAN that supports DOS-based file locking.

SOME END-USER TOOLS

Commander, which first appeared in Version 3.0 of KnowledgeMan, is a menu-driven shell from which you can define and query databases, invoke an informative tutorial, or launch other KnowledgeMan tools such as the screen and reports designers. Unfortunately, the documentation for Commander is incomplete (some features are not described), and the on-line help is inadequate. For example, the Define Table option brings you to a screen with fields you need to fill in, but no instructions whatsoever about which keys to press or how to enter the information. And some of the error messages that appear when you incorrectly enter data are unintelligible.

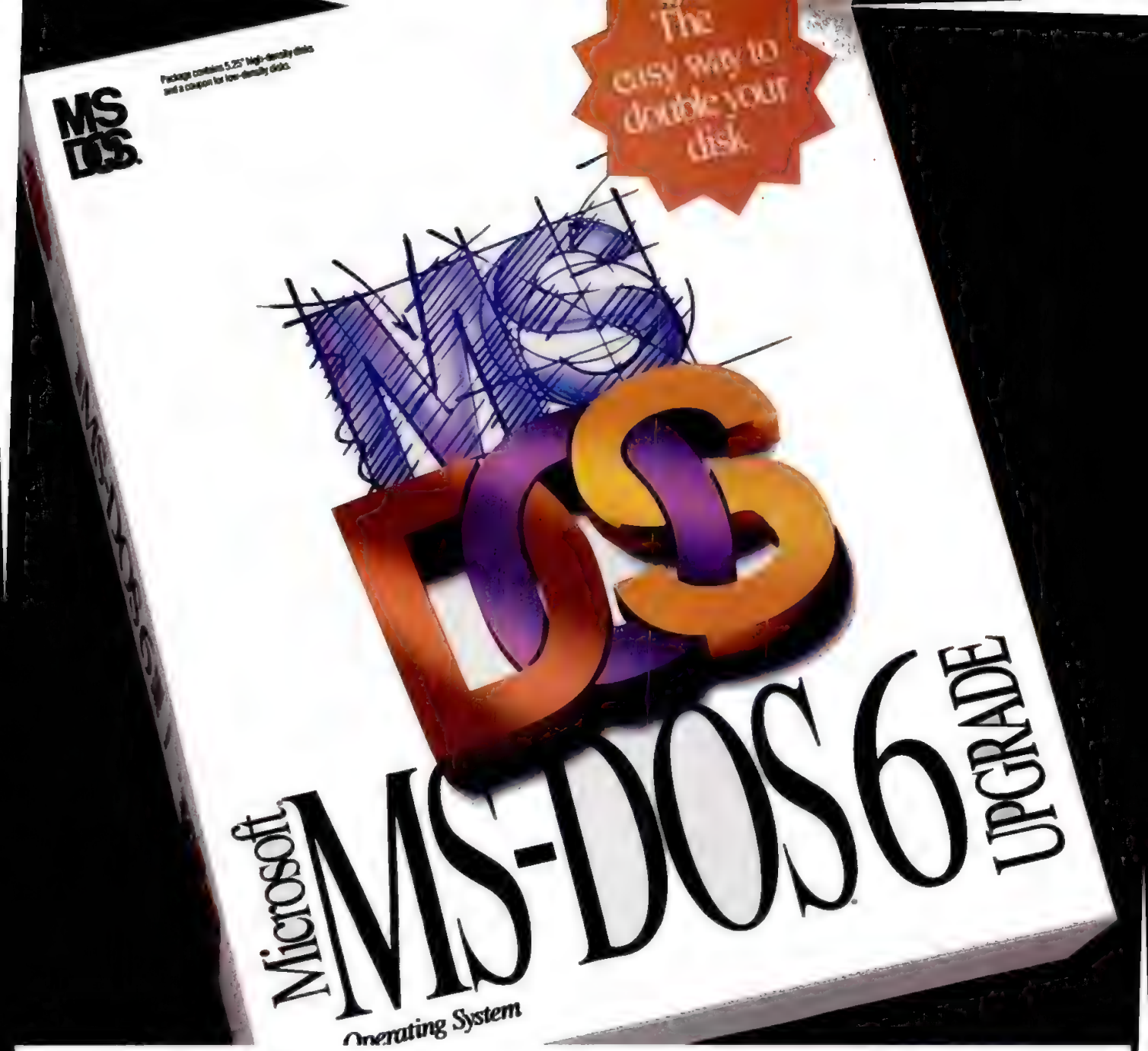
The query feature in Commander generates the appropriate SELECT com-

FACT FILE

KnowledgeMan, Version 3.1
Micro Data Base Systems Inc., P.O. Box 6089, Lafayette, IN 47903; 317-447-1122

List price: Single-user version, $1,495, server version, $2,995.
Requires: 286-based PC or better, 640K RAM, 5MB hard disk space, DOS 3.1 or later.
In short: Version 3.1 of KnowledgeMan is a powerful developer's package that can meet just about any database applications programming task. Its integrated environment includes modules for such extras as asynchronous communications and business graphics. KnowledgeMan also boasts flexible concurrency controls, along with robust security features. There are also versions available for a variety of platforms. Be aware that this package does not cater to novices, however.

400 ON READER SERVICE CARD



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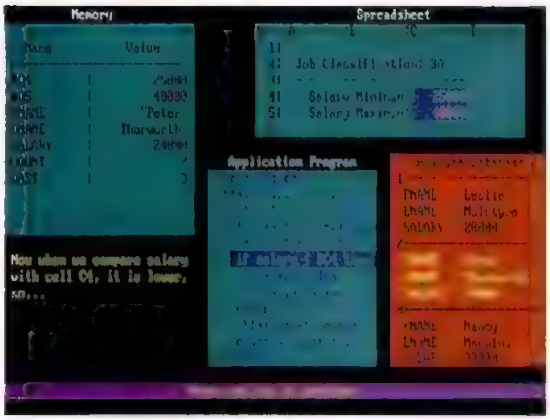
mand as you choose the desired tables and fields from displayed lists. You can save the generated SELECT commands for use at a later time. Because KnowledgeMan does not support the establishment of application-wide relationships between tables, there is no support for referential integrity, and the relationships in multitable queries must be specifically included as part of the SELECT command syntax.



KnowledgeMan's tutorial provides an excellent introduction to the integrated environment.

The PAINT command provides an interactive, menu-driven means to design data entry screens. PAINT lets you easily draw borders, select colors, and locate elements on the screen. However, you cannot select fields to place on a form from a list of table elements; you must enter them manually. Also, you cannot control the order in which the elements will be entered by the end user, unless you do some programming.

DESIGN, the report designer, has a similar interface as PAINT, and it lets you generate reports from multiple tables. It supports the creation of headers, footers, and statistics, including totals. DESIGN lets you specify up to 255 control breaks.

A primitive code generator called EZ-App is also included with the package, but you might not realize it is there, because it's completely undocumented. EZ-App is a new addition to Version 3.1, and it will be better integrated with the next product release.

Both Commander and EZ-App are written in KnowledgeMan's programming language, KGL (which stands for KnowledgeMan GURU Language). Full source code is provided for Commander, so you can modify it to suit your purposes.

PROGRAMMER'S ENVIRONMENT

To access the real power in KnowledgeMan, you have to do some programming. KGL is powerful enough to handle virtually any application. It is compatible with SQL and provides approximately 120 commands and 150 built-in functions. You can save and restore screen contents, manipulate DOS files, determine available memory, create menus, and edit text. Many of the built-in functions are highly configurable. For example, the Menu() function accepts up to 13 optional arguments, allowing you complete control over screen presentation. If you need a feature that's not provided, you can create your own user-defined functions with KGL, or you can link in functions written in C or assembler.

KnowledgeMan also supports event-driven programming. There are commands that let your code gain control when specified events occur. A wide range of events can be trapped, such as pressing an exit key and receiving data from the communications module. New to Version 3.1, you can also have your code gain control based on mouse positioning, mouse button clicks, and timed events.

You can edit KGL programs from within KnowledgeMan by using TEXT, the built-in text processor module, or you can specify with the #EDITOR utility variable that your own text editor be invoked in response to the TEXT command.

The supplied debugger is powerful and easy to use, supporting breakpoints and variable watchpoints within an intuitive, windowed interface. You start the debugger by setting an environment variable, E.DBUG=TRUE, or by pressing Ctrl-C at any time during the execution of your application.

KnowledgeMan code is pseudo-compiled, so it requires a runtime module for distributing applications. The pricing for the runtime modules begins at $150 for the server version and $75 for the single-user version.

Excellent technical support is available via the telephone and bulletin boards, and these are free of charge for the first 90 days. You can purchase service and maintenance policies on a yearly basis: $450 for the single user version and $895 for the server version.

DESIGNED FOR MULTIPLE USERS

KnowledgeMan provides excellent concurrency controls through its exclusive- and shared-access levels. Exclusive access locks entire tables for operations such as packs or index creation. Shared access provides locks on single records or groups of records when commands such as SELECT are executed. You can also explicitly program individual record locks and releases into applications.

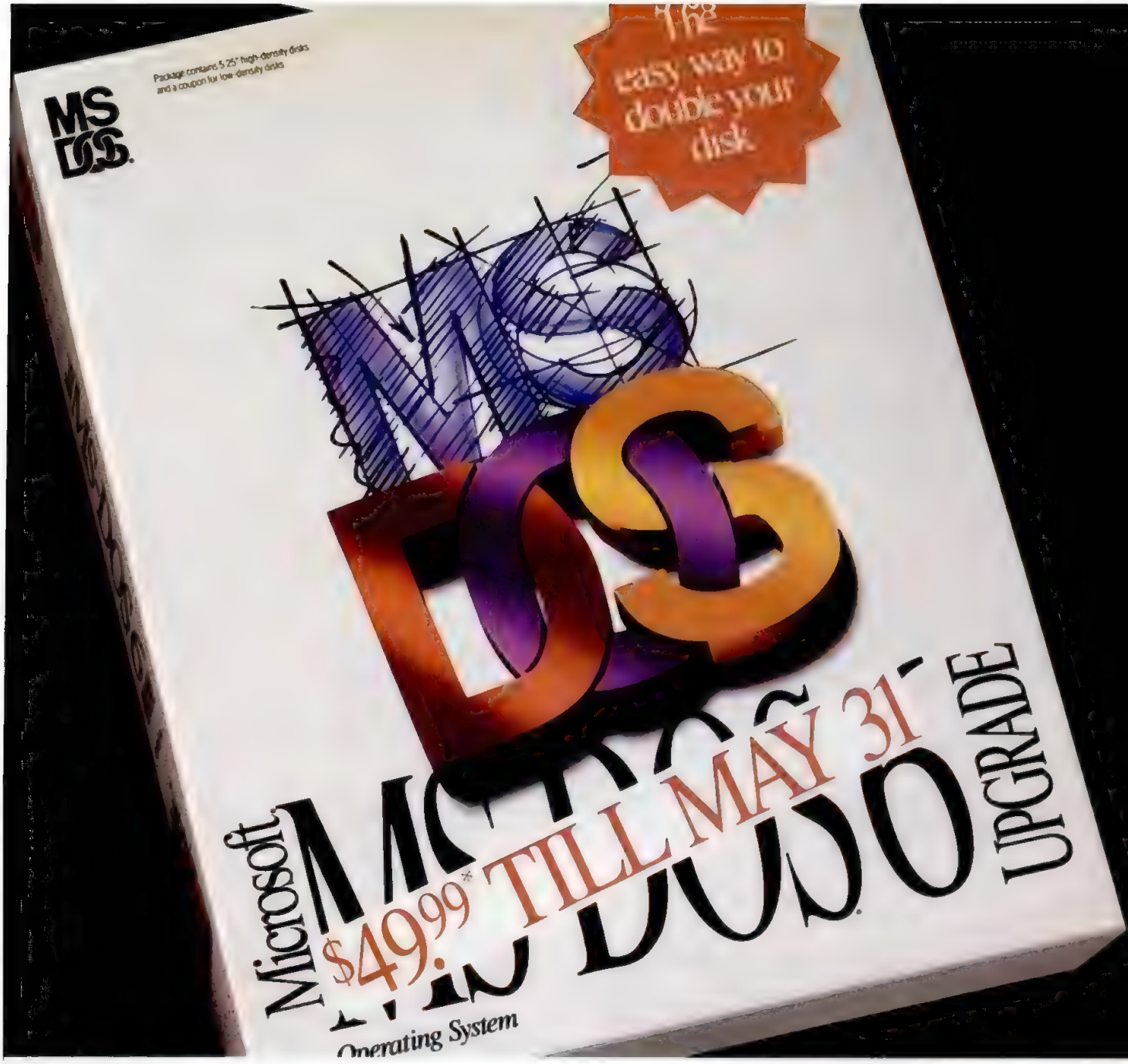
Another outstanding aspect of KnowledgeMan is its security features. You can password-protect tables or individual fields, and you can assign 16 different levels of read and write security to tables. And for an extra measure of security, you can encrypt databases and applications.

If you have the hardware, KnowledgeMan can handle enormously large databases. A database can hold up to 240 tables, each of which can consist of as many as 2 billion records. The maximum record size is 65,535 bytes, but you can exceed this limit by using a special data type called a BLOB (for binary large object), which can hold up to 2 billion bytes of data.

BLOBs are useful for storing graphics or audio data, executable code, or any other type of data you want to associate with a database record. For example, employee records could contain a digitized photograph along with the usual demographic data. BLOB fields are not directly supported for import or export with the high-level KnowledgeMan com-

SUITABILITY TO TASK

KnowledgeMan	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	○	○
Professional development	●	●	●	○
Querying and reporting	●	●	●	○
Connectivity	●	●	●	○



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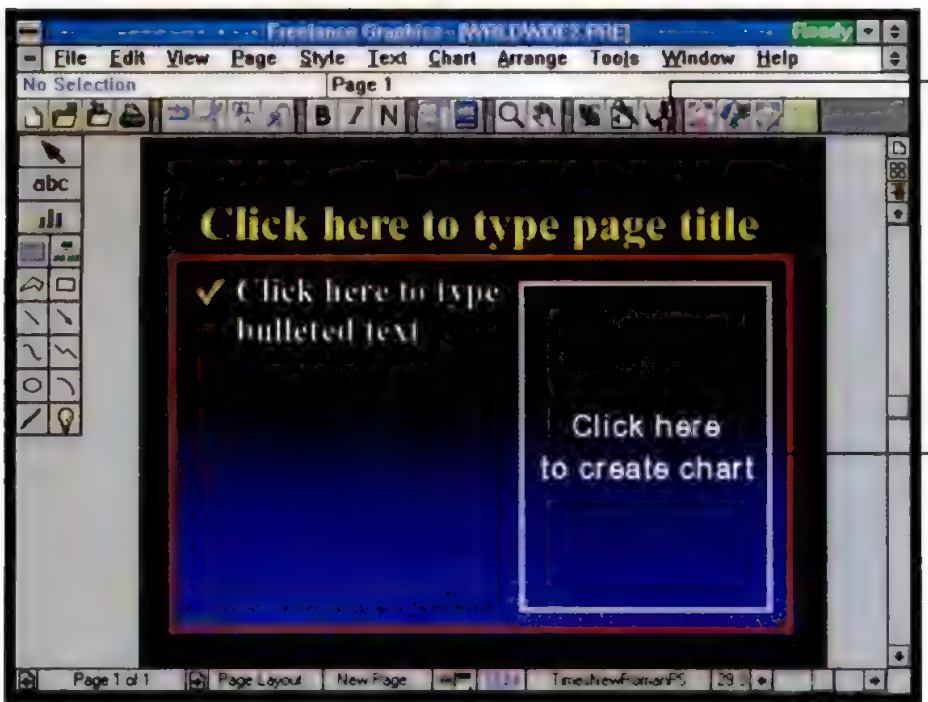

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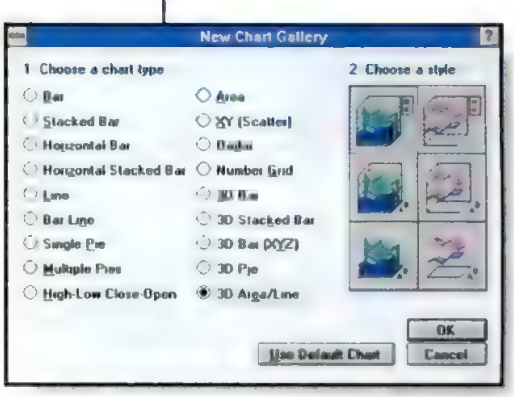

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How We Tested

To evaluate the performance of the multiuser databases in this roundup, PC Magazine Labs developed a suite that tests each product's limits on a broad cross-section of database operations, and measures each product's throughput in an extremely demanding multiuser environment. As in previous comparisons, ***PC Magazine*** chose to use a subset of the AS3AP (ANSI SQL Standard Scalable and Portable) Benchmark Tests for Relational Database Systems, developed by Carolyn Turbyfill, Dina Bitton, and Cyril Orji at Cornell University. AS3AP is an industry-accepted suite of tests that covers a broad spectrum of common database operations and is also scalable, providing valid results on platforms from PCs to mainframes.

This year, PC Labs made a few modifications to its test-bed. While last year's tests focused almost exclusively on multiuser issues ("Nine Multiuser Databases: Robust and Ready to Share," ***PC Magazine***, March 31, 1992), this year's battery of tests included several tests to evaluate the performance of selects, joins, and updates from a single workstation. The test-bed was upgraded as well. For the single-user tests, we used a Compaq Deskpro 486/33M with 8MB of RAM and a 310MB hard disk. The file server was a Compaq Systempro 486/33 with 32MB of RAM (up from 16MB for last year's story) and 1.6GB of high-performance hard disk storage using Compaq's IDA (Intelligent Drive Array) controller.

To increase the load on the network tests while avoiding hardware bottlenecks, PC Labs tested up to 36 workstations and balanced the network traffic symmetrically by using two Madge 32-bit EISA Token-Ring adapters in the file server. The workstations were identically equipped 386SX/16-based Compaq Deskpro 386N's with 5MB of RAM. We conducted all tests using NetWare 3.11 on a 16-megabit-per-second Token-Ring network.

We gave each vendor a detailed testing specification prior to running our tests, and we requested optimized code modules developed in the reviewed database management system (DBMS) to accomplish each operation. The vendors were not allowed to use any programs developed or compiled with tools that are not included with their products. In addition, a representative from each vendor was present at PC Labs for a week of testing to ensure that the products were properly installed and tested.

All products were installed in a multiuser configuration. We installed the reviewed DOS products on the network file server, while Windows-based products were installed locally on each workstation, along with Microsoft Windows 3.1.

The **Load and Index** test measures how quickly each database package can import and index a four-table database with 100,000 rows per table. Two tables contain two indexes each, one table contains four, and the remaining table contains five.

Each table has its own distinct data-distribution characteristics: One contains unique values for each column, another contains 10 percent unique values for each column, the third contains 100 distinct values for each column, and the fourth uses various distributions and is used for tests involving updates. The import files are located on a NetWare volume and physical disk channel that are separate from the destination database, and the importing and indexing are executed from the 486/33 workstation.

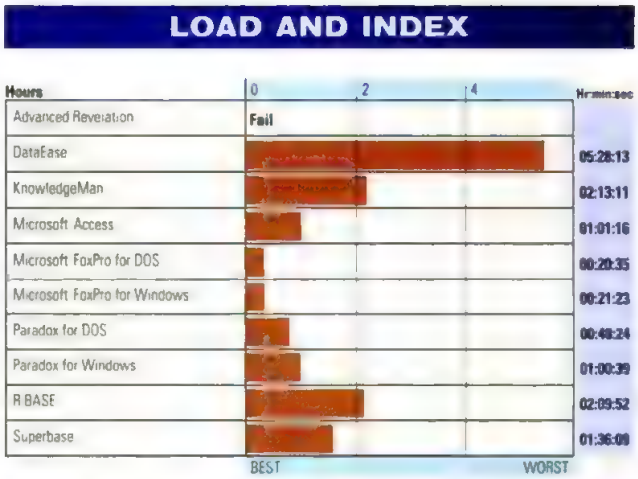
Before testing, we let each vendor specify its preference for files in unquoted, comma-delimited ASCII or fixed-length ASCII format.

Both Microsoft FoxPro for DOS and Microsoft FoxPro for Windows excelled on the Load and Index test, completing both steps in about 21 minutes each—less than half the time of the next-place product, Paradox for DOS. DataEase was by far the slowest product on this test. Although DataEase loaded all four tables in less than an hour, slow indexing produced a total time of about 5.5 hours.

Paradox for Windows required a two-step procedure to import the data. While the DOS version had an Append Delimited command to add data to an existing table and could typecast the data from the original ASCII file on the fly, Paradox for Windows required an Import operation, followed by a Table Add operation, to achieve a similar goal. This doubled the processing time, since each record had to be processed twice.

When Advanced Revelation imported each of the four test tables, we discovered a bug that resulted in varying degrees of data loss during this procedure. Since the product could not successfully load the tables and create accurate indexes, its score on the Load and Index test is "Fail."

The **Select** test measures how quickly each database package can perform single-table queries where 10 percent of the rows are returned. We performed two types of queries. The numeric select uses the primary key of the table and a sequential range as search criteria. The alphanumeric query performs an exact-match query on a text field using a secondary index.



Fail—The product could not complete this test.

Three of the products tested—Microsoft Access, FoxPro for DOS, and FoxPro for Windows—returned a list of pointers to the selected data in memory, and not the actual value of the specified columns. Although these products execute the query request almost instantaneously, they must spend additional time to retrieve the actual data if a further operation is to be performed on the result set. Since products like Paradox and R:BASE return the data while executing each query, they do not require this additional access to the database.

Since Access uses background query processing and returns control after the first screen of data is made available, we issued a command within the timing loop of the test that instructed Access to jump to the end of the dynaset; thus, we were able to ascertain the total processing time of the query.

Although both versions of Paradox turned in extremely fast times on the numeric portion of the Select test, the alphanumeric Select times suffered from an inefficient use of the secondary index. With Paradox, if the result set of a query is less than approximately 8 percent of the entire table, the secondary index helps performance; above that threshold, the index hinders performance. Our alphanumeric query returned 10 percent of the table.

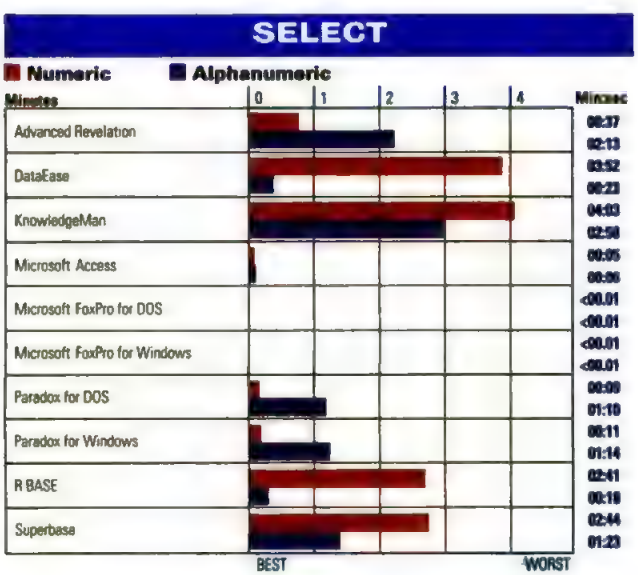
For the **Join** test, we executed several of the joins specified in the AS3AP suite.

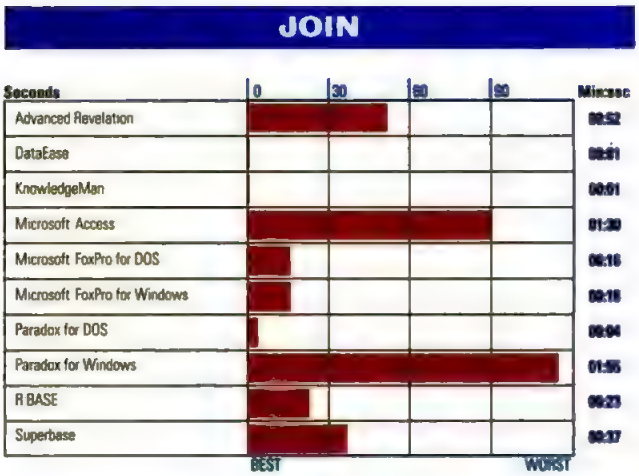
Although joins that returned small result sets were generally processed quickly, the two-table one-to-many join produced a wide range of performance, depending on the optimization scheme used.

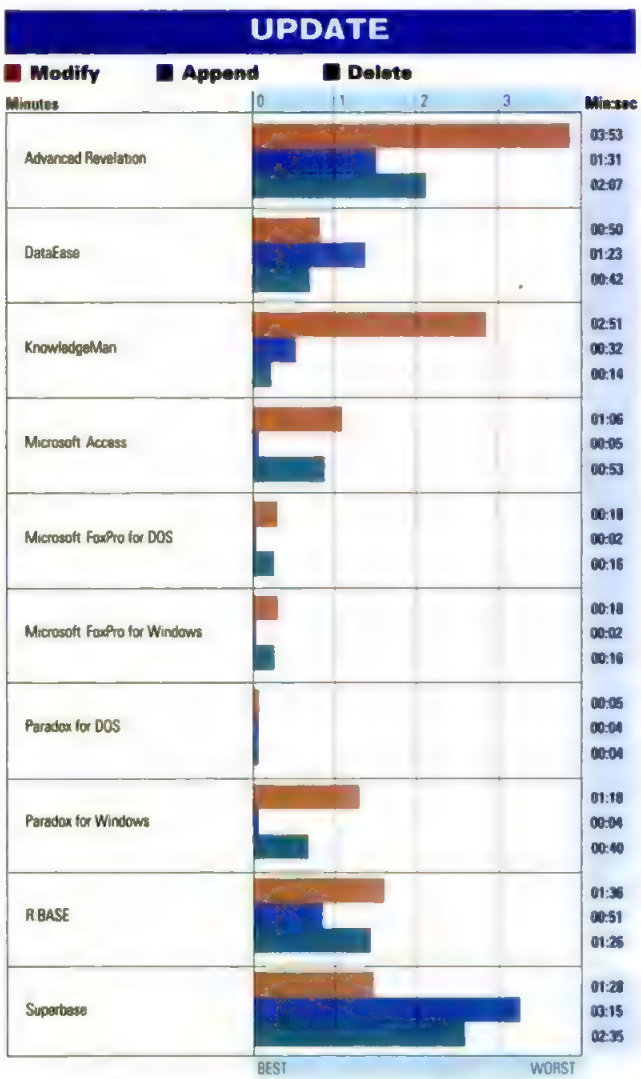
DataEase, KnowledgeMan, and Paradox for DOS optimized the query used in this join exceptionally well. By contrast, Paradox for Windows and Access turned in the slowest times. Unlike Paradox for DOS, Paradox for Windows uses Borland's Interbase database engine, which, in its first release, is not tuned for performance.

For the **Update** test, we perform bulk updates, insertions, and deletions (Modify, Append, and Delete, respectively). First, we save a 1,000-row subset of the table to a temporary table. Next, we update the corresponding range in the middle of the test table and change the value of the primary key, which forces the database to update its index. To measure the products' speed when inserting records into the table, we insert 1,000 rows into the middle of the test table. Finally, we delete 1,000 rows from the table.

The most difficult of the three operations for most products was updating. Advanced Revelation and KnowlegeMan both took an exceptionally long time to do this, because of the required index reorganization. Paradox for DOS proved very efficient at performing all three operations, completing each within 5 seconds. Both versions of FoxPro also proved relatively quick in handling the Modify task.







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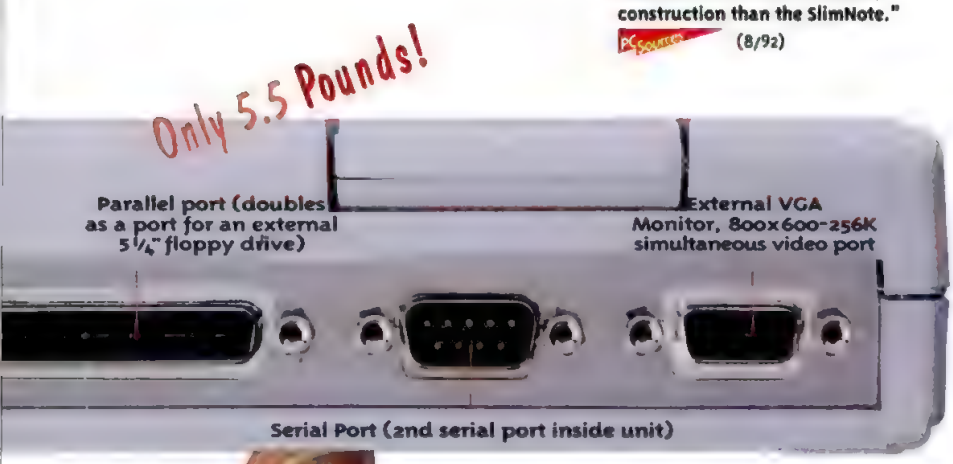

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Performance Tests: Relational Databases

The **Random Read** test gives an idea of the maximum number of concurrent retrievals each package can handle. In this test, each workstation randomly selects rows from the same table and discards them by directing the output to device NUL. Records are accessed in browse mode to maximize the amount of concurrency.

We run the test for 2 hours 10 minutes. To determine where peak throughput occurs, we increase the number of workstations gradually, adding stations at 10-minute intervals until 36 workstations are running or until the server can no longer support more connections. Throughput is calculated in transactions per second for each 10-minute interval.

Again, since there is no "think-time" inserted between each repetition of the test, the network load is many times what the same number of workstations would produce in a real-life situation.

Three products—FoxPro for DOS, FoxPro for Windows, and Paradox for DOS—stand out; each achieved a throughput of over 3,000 transactions per second with a 36-workstation load. Although Paradox for DOS peaked at 32 workstations, the throughput curve for both versions of FoxPro remained essentially linear up to 36 workstations, indicating that the maximum throughput for the product had not yet been achieved. Access also performed consistently on the Random Read test, reaching 846 transactions per second with 36 workstations and not yet peaking. Paradox for Windows' performance on our Random Read test was disappointing, peaking at six workstations and then stabilizing at about 60 transactions per second.

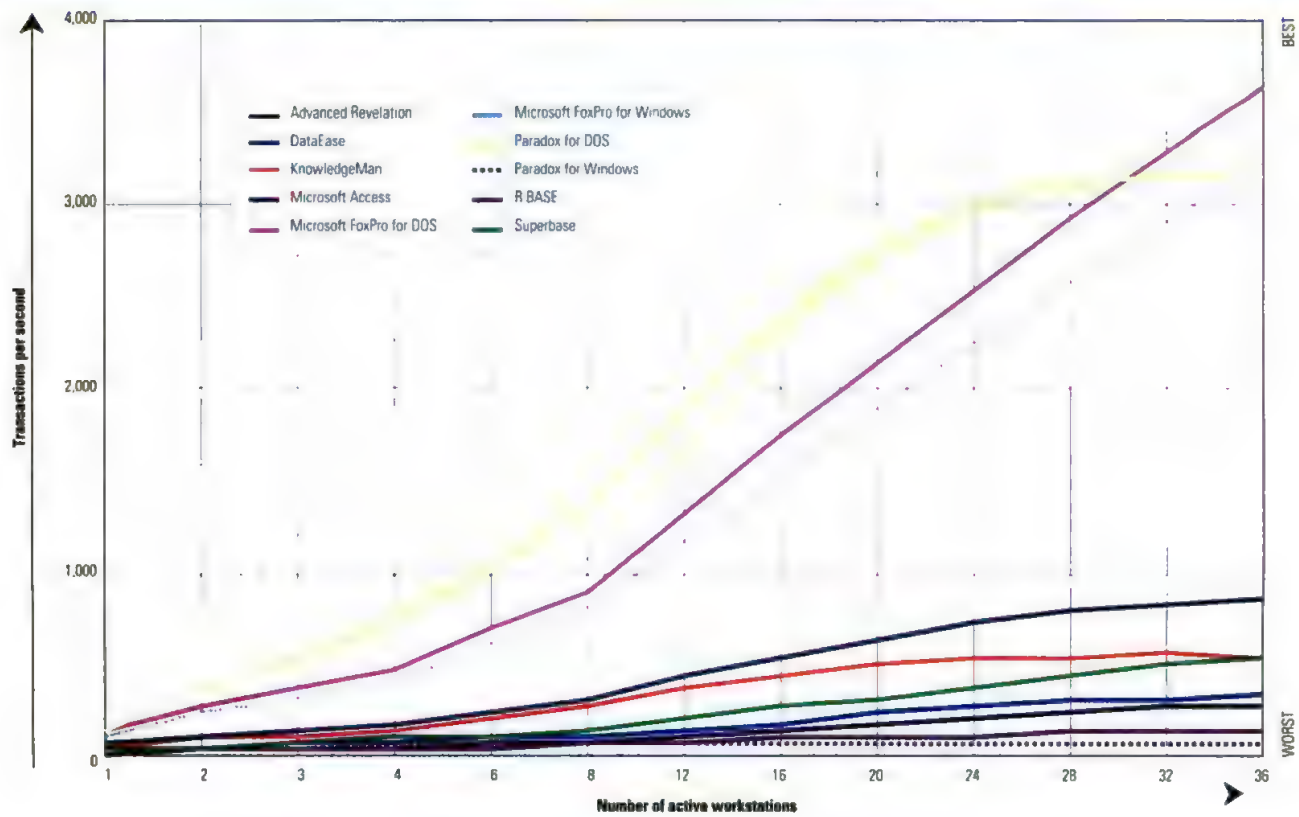
For the **Report Generation** test, one workstation prints a report while eight other workstations perform the Random Read test in the background. To produce the report, the package has to join two 100,000-row tables and generate a 1,000-row summary using date calculations, minimum and maximum values, subtotals, and totals. The results are printed to an ASCII file on the workstation that is generating the report.

Again, certain products performed considerably better than the rest. Both versions of FoxPro, Paradox for DOS, and Access all produced the report considerably quicker than the other products did. Each version of FoxPro completed the test in under 2 minutes. At the other end of the spectrum, KnowledgeMan and Paradox for Windows each took over half an hour to complete the report, and R:BASE was the slowest, taking 46 minutes.

The **Random Write** test gives an idea of the maximum number of concurrent updates the package can perform. In this test, each workstation randomly updates single rows from the same table. We modify the value of a nonkeyed indexed field so that both the selected row and the index must be updated. Rows are accessed in update mode, which permits data sharing in the table but does not allow any other workstation to access a row that is currently being updated.

We run the test for 2 hours 10 minutes. To determine where peak throughput occurs, we increase the number of workstations gradually, adding stations at 10-minute intervals until 36 workstations are running or until the server

RANDOM READ



can no longer support more connections. Throughput is calculated in transactions per second for each 10-minute interval. Since no "think time" is inserted between repetitions of the test, the network load is many times what the same number of workstations would produce in a real-life situation.

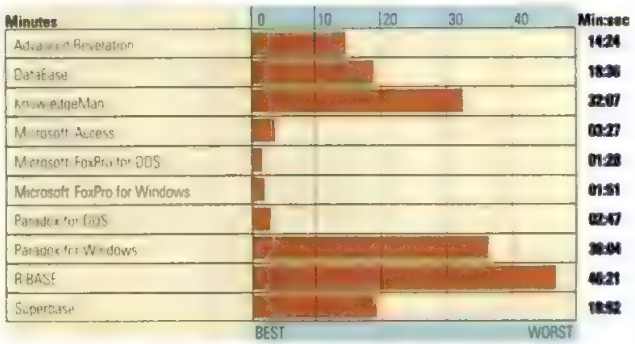
Both versions of FoxPro stood apart from the pack. The performance graphs show that their throughput was just leveling off at 36 workstations with about 770 transactions per second—almost three times the throughput of the next-best performer on this test, DataEase.

Both versions of Paradox labored on this test, because of the high number of simultaneous lock requests. To obtain record locks on the same table, Paradox workstations must acquire "critical section locks" on the same semaphore file. For concurrent lock requests to a single table, Paradox clients must access this semaphore file in a serial process, creating a substantial performance bottleneck. Paradox for DOS peaked at 3 workstations, with a total throughput of 42 transactions per second, while Paradox for Windows peaked at only 5 transactions per second during the test.

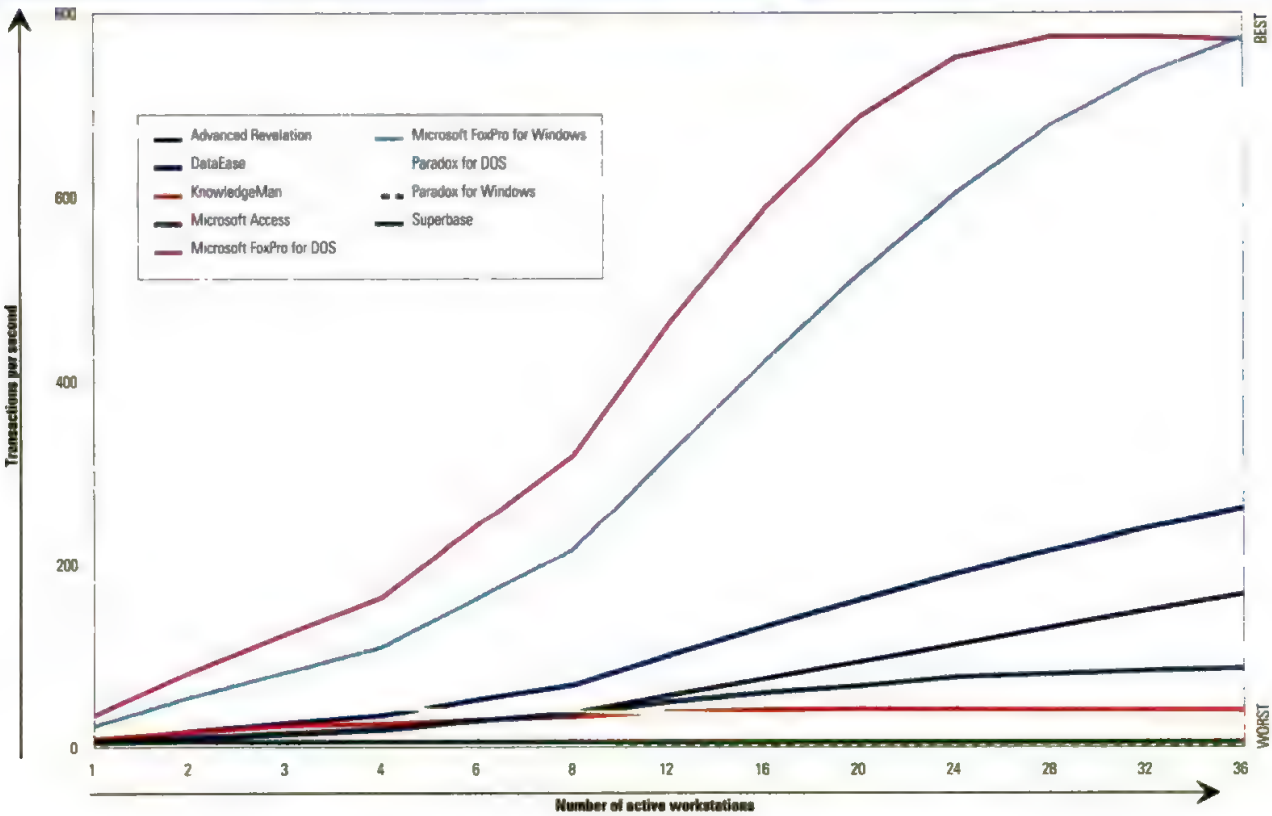
Superbase also gave a poor showing on our Random Write test, because we were obliged to use table locking instead of row-level locking. The product could not successfully complete the test with row-level locking in place.

At the completion of the Random Write test, PC Labs ran a verification routine to ensure that every logged update was successfully completed to the database. Because of a bug in R:BASE involving locking contention, the product could not successfully complete all of the updates, so we did not present its results on this graph. Microrim has made a patch available to correct this problem, but it was not available in time for our tests.

REPORT GENERATION



RANDOM WRITE



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To find out more about the multiple-network HP LaserJet 4Si MX printer and the upgradable HP LaserJet 4Si printer just call 1-800-LASERJET, Ext. 7299.† Capabilities this advanced make a world of difference—in any environment.

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mands, but you can write your own code to do so by using the provided functions for manipulating BLOBs. KnowledgeMan can import and export data from several file formats, including ASCII, .DBF, .DIF, .SDF, and .WK1. But it can directly access files only in its own, native format.

KnowledgeMan's performance on our tests hovered near the middle of the pack. Because of its efficient index handling and automatic locking functions, which hold records only as long as necessary, KnowledgeMan's best results came from tests involving updates and reads under heavy work loads.

For an extra measure of security, KnowledgeMan lets you encrypt databases and applications.

Though relatively inaccessible to nonprogrammers, KnowledgeMan is a powerful and adaptable tool for professional database developers. Its strong security features, flexible concurrency controls, and competitive server pricing make it best-suited for use in a multiplatform environment.

Microsoft Corp.

Microsoft Access

BY DAVE BROWNING

With its introductory price of $99, Version 1.0 of Microsoft Access flew off the shelves when it was released this past November. Never has a new database sold so well in so short a time. But how does this Microsoft Windows database system really stack up against the competition?

Access provides a wealth of powerful tools for getting a database system up and running with a minimum of programming. But if you need to develop applications that are truly "end-user–proof," you will find a significant number of design weaknesses that make it difficult and sometimes impossible to protect against every hazard.

IMPRESSIVE USER INTERFACE

Perhaps the best-designed feature of this package is its user interface. The interface includes a toolbar and status line; a well-thought-out Database Container that groups the database's tables, queries, forms, reports, macros, and program modules; a flexible QBE capability; and an intuitive, spreadsheet-like view of data tables. The interface is designed to give users quick access to sophisticated features. The automated help facilities that Microsoft Corp. has built in include Cue Cards, a kind of on-line coach that offers step-by-step instruction; and Wizards, which lead you by the hand as you perform intricate operations, such as the creation of forms and reports.

Access makes extensive and good use of the Windows environment's graphical capabilities and editing functionality. To place a data field and its associated prompt label, just drag a field name and drop it onto a form or report. To embed a subform or subreport, simply drag one form or report onto another. You can copy a table, query, form, report, or macro to the Clipboard, and then paste it with a new name back into the Database Container. The query box is especially well-designed. Tables are shown as boxes containing lists of available fields. To specify links between tables, you simply draw lines between fields. To define the result table, just drag fields onto the result grid in the lower portion of the query box, where you also specify sorting and selection criteria.

The reporting capabilities are equally impressive, with built-in sorting and grouping, and calculated fields. The powerful subform capability trivializes the chore of displaying both parent and child data simultaneously; you need only drag one form or report onto another. Sections ("bands" in dBASE terminology) and fields can shrink or grow automatically, according to the data that fills them. If you're printing a number of detail records that share field headings, Access lets you suppress the fields display on successive lines but have it repeat it at the top of each page.

A SOLID ENGINE

Access can read and join tables in numerous file formats, including Btrieve; dBASE; Paradox, Version 3.5; and SQL Server (through ODBC). There are some restrictions. You can modify the contents of the database, but you can't change its structure unless the database is a native Access table.

The import/export facility for converting data to native Access tables supports numerous formats, but it's not as well designed as the rest of the package. You must type in field names; there is no list from which to choose. And for fixed-length data, each record must be padded with trailing blanks to exact length.

Access provides three methods for resolving queries. The first two methods—saving result sets to disk or bringing them into memory—take the traditional approach and make copies of the underlying tables. The third, a clever method also shared by Microsoft FoxPro, is to create a "dynaset"—a set of pointers into the live data, rather than static copies of query results. Dynasets return the result set almost instantaneously, and the records are updatable.

For queries not involving operations on the entire data set (such as sum or average operations), Access provides almost instantaneous results and continues to process the query in the background.

FACT FILE

Microsoft Access, Version 1.0

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329

List price: $495.

Requires: 386-based PC or better, 2MB RAM (4MB recommended), 8MB hard disk space (14MB recommended), Microsoft Windows 3.x

In short: Microsoft Access, Version 1.0, is an end-user–oriented relational database system for Microsoft Windows. Highlights include a superb user interface, updatable views, graphical QBE, and direct use of data in foreign formats. While Microsoft Access is powerful enough for most purposes, its development tools have design weaknesses that restrict this package's usability where critical applications are concerned.

476 ON READER SERVICE CARD

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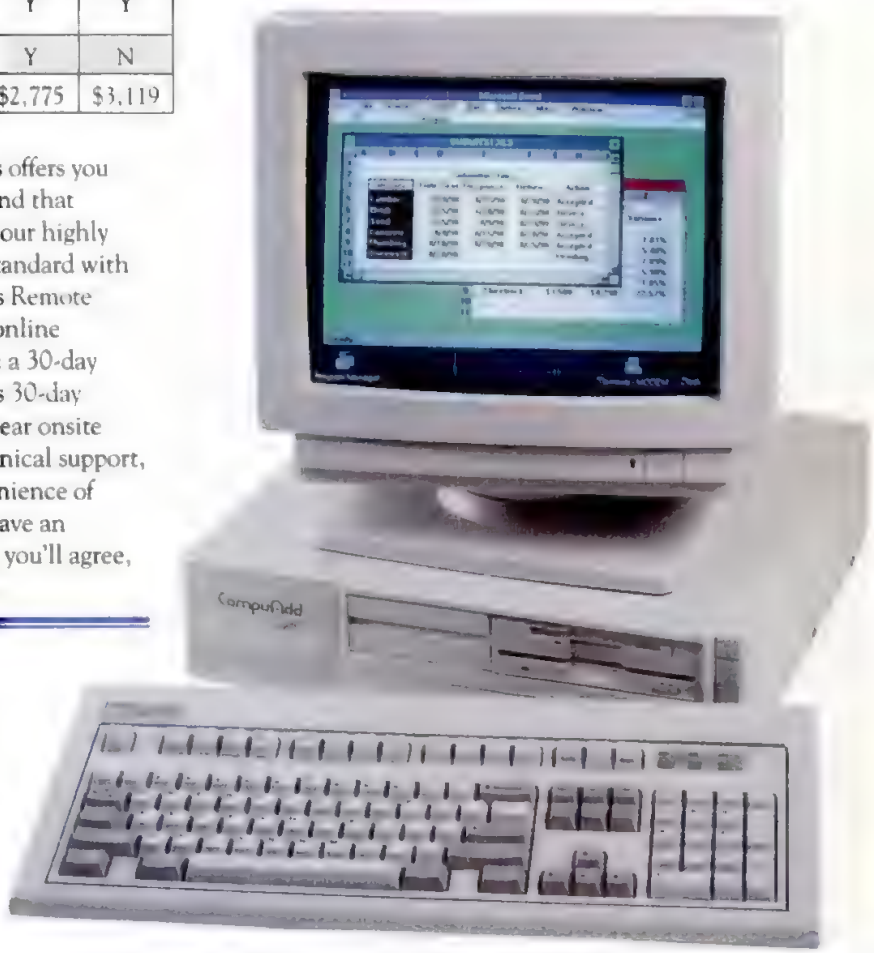

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CIRCLE 131 ON READER SERVICE CARD

dBASE IV: *Borland Brings Speed*

by Dave Browning

dBASE has been around for years—it's even older than the PC itself—and millions of lines of dBASE code have produced tens of thousands of applications over the years. The dBASE architecture has been used as a basis for numerous lookalike products (generically referred to as Xbase products), several of which have surpassed dBASE in speed and features.

When Borland acquired Ashton-Tate, many of us wondered if dBASE was dead, with pieces of the carcass to reappear in other Borland products. Our preview of dBASE IV, Version 2.0, in beta at the time of this writing, shows that dBASE is alive and well. Version 2.0, which will be shipping by the time you read this, brings with it some sorely needed performance enhancements. In addition, Borland is rolling out a new compiler, the dBASE Compiler for DOS, which should make dBASE even more attractive to developers.

dBASE IV was one of the first database products to gather together the elements of a database into a central location (what dBASE dubs the Control Center) where you can directly access any data table, query, form, report, label, or program procedure in your application. Despite the character-based DOS interface, you can draw forms or reports on the screen and let dBASE create the underlying code. Behind the scenes is a flexible programming language with the power to create substantial multiuser applications.

THE NEW SPEED DEMON

One of the major problems of dBASE IV was lack of speed; in recent years clone products have run rings around it. Borland's Version 2.0 release breathes new life into this venerable workhorse by concentrating on performance. At the same time, it offers some new functionality to developers and a faster, more user-friendly installation program.

dBASE now benefits from Borland's index algorithm technology, which provides substantial speed improvement by itself. However, the most significant improvement is that dBASE now uses indexes wherever possible. In the past, a "SET FILTER TO. . ." operation would ignore existing indexes and plod through a file record by record; now it uses available indexes to zip through filtered files. The use of indexes is extended to any operation involving a "FOR" condition, speeding up a large majority of common operations. QBE also benefits. If you narrow your filter with another AND condition, dBASE will start from the previous result set rather than starting over as in the previous version.

The dBASE IV Control Center brings together all the elements of a database: Data, Queries, Forms, Reports, Labels and Applications.

These changes, along with other improvements such as the DMPI-compliant use of extended memory, can make dBASE applications many times faster than before. We ran a late beta version of dBASE through our performance test suite to investigate Borland's speed claims. True to the company's advance publicity, dBASE IV 2.0 is speedy. It scored well across our test suite and beat all the Xbase languages on writes to a fully loaded network. With scores of 1 second and 2 seconds on our numeric and alphanumeric Select tests, dBASE IV came in only a fraction of a second behind the Microsoft FoxPro products. If the beta version we tested accurately reflects the speed of the final release, Borland's dBASE will exhibit top-shelf performance.

LANGUAGE ENHANCEMENTS

Version 2.0 contains a few enhancements to the programming language, particularly in the area of user interface design. Although earlier versions of dBASE IV recognized a mouse, until now you couldn't incorporate a mouse into your application's user interface. New commands such as ON MOUSE recognize the user's click of the left mouse button, and the MROW() and MCOL() functions tell your program the mouse's current screen location. In addition, you can now program mouse-driven radio buttons, check boxes, and check lists into the applications you develop.

Other functions have also been added or enhanced: The KEYMATCH() function checks to see if an expression is found in a specified index; the TIME() function can return the time to hundredths of seconds; and the MEMORY() function returns details about dBASE's memory utilization.

Error trapping is also improved. dBASE can now detect when the disk is full or damaged or when a file is missing. The debugger lets you set breakpoints using Ctrl-T and execute the currently highlighted command with Ctrl-L. These and some navigation keystroke enhancements make the debugger more usable, though it is still not perfect.

A COMPILER, THEN WINDOWS

The dBASE Compiler for DOS ($495) is also in beta testing and is expected to ship around the same time as the new

dBASE IV. Compatible with all versions of dBASE III PLUS and dBASE IV, the compiler builds .EXE files in two optional models. One model incorporates the library functions; the other compiles to a smaller .EXE and makes calls to a runtime library. End users can run the standalone executables without any additional dBASE system files, and developers can distribute .EXEs free of licensing fees.

A Windows version of dBASE IV, which will share the same engine as Borland's Paradox for Windows, is also in the works. Originally slated as a compiler-only product, Borland has decided to include screen design and end-user tools in the initial release, which has pushed the release date to the end of the year at the earliest.

Improvements such as the DMPI-compliant use of extended memory can make dBASE applications many times faster than before.

All in all, this new version is the shot in the arm dBASE IV has needed for years. The improved performance, especially in multiuser environments where large databases are the norm, will make it a hit with current dBASE shops and should win over customers who were considering going elsewhere. □

▶ FACT FILE

dBASE IV, Version 2.0

Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067-0001; 800-331-0877, 408-438-8400

List price: *$795; upgrade from previous version, $99.95.*

Requires: *286-based PC or better, 2MB RAM, DOS 3.3 or later.*

Circle 484 on reader service card

We deliberately disabled this capability disabled during our performance testing; the numbers we print in the performance section represent the time to complete a query in full. Immediate access to a portion of the retrieved data may benefit some users; certainly the database is *perceived* as being lightening-fast.

Unless you take steps to separate them, Access stores all components of the database in a single .MDB file; these include the user interface, code, and data. When using Access, it is a good idea to separate the user interface, live data, and static lookup data portions into three separate .MDB files. This lets you load the user interface at the workstation, thereby reducing network traffic, and it makes the application easier to maintain. It also lets you get around the 128MB limit on .MDB files. Since the separate .MDB files must be attached, the additional overhead produces a performance loss; the effect is relatively slight, though. Microsoft representatives choose this approach when providing code for our performance tests. Our tests showed Access to be a solid performer. Its strongest showing was on the Select test, where it placed right behind the blindingly fast DOS and Windows versions of Microsoft FoxPro 2.5.

Microsoft Access's Database Container lets you immediately access and simultaneously view all the database elements.

PROGRAMMABLE, WITH LIMITATIONS

The Access macro language consists of over 40 functions for opening forms, updating tables, and launching queries. It is adequate for many applications. For greater customizability, you can use Access Basic—a dialect of BASIC with database extensions—to write your own functions. Macros and functions are accessed through an object's property box, where you specify macros or functions to call when triggering events occur.

Still, some common programming tasks can be awkward to implement within Access. Let's say you want to print a bar chart with numbers printed on each bar. A label control can't be used for this, because label text cannot be changed at runtime. A text box can, but because it can't have a "clear" background, you cannot see the bar color through it. It takes a significant amount of programming to get around such limitations.

Another design deficiency is that empty strings are automatically converted to null strings, so if you read fields without checking for nulls, you'll get error messages. This saddles programmers with the inconvenience of checking for nulls each time they do a read.

There are significant gaps in Access's SQL dialect, too: It does not include the CreateTable, DropTable, Subselect, and Union commands. Workarounds exist but are clumsy.

TRESPASSING ALLOWED

Access makes it difficult (and occasionally impossible) for programmers to make an application completely bullet-proof. For example, Access automatically presents users with an option that lets them add new rows to tables, even if you only want them to have update privileges for existing data. It takes significant programming effort to get around this. Another problem is that menus can't be grayed out, and items within menus can't be changed dynamically at runtime. There is also a security hole in the print preview display; the native Access menus appear, letting users make fundamental

SUITABILITY TO TASK

Microsoft Access

				EXCELLENT
End-user applications	●	●	●	●
Professional development	●	●	○	○
Querying and reporting	●	●	●	●
Connectivity	●	●	●	○

database changes, and there is no way to turn them off.

Probably the most difficult aspect of Access for the developer is its inability to print all the components of your database design, such as database schema; query definitions; macro mapping; code cross-references; and property settings for controls, forms, and reports. An included database-analyzer program provides some help, but not much.

The lack of documentation tools can exacerbate other problems. Design modifications such as changing the name of a field do not propagate between forms, tables, reports, macros, and queries. This is especially inconvenient, since you can't easily locate all the places where the field is used. These difficulties can eat up the time saved by the user-friendly interface.

Immediate access to a portion of retrieved data may benefit some users; certainly the database seems lightning-fast.

SUPPORTING ROLES

The documentation for Access is complete and well-organized. On-line help is extensive, and the Cue Cards walk you through common operations such as table design. Free technical support is available for the cost of a call. If you have a modem, you can get additional help from the CompuServe MSACCESS forum, where Microsoft posts known bugs and workarounds, and the Microsoft BBS. For an additional $295 per year, you can purchase a developer's support package that includes priority support, technical information mailings, and free access to the CompuServe MSACCESS Forum.

Access does not provide serious developers with the tools they need to have full control over their applications. But with its superb user interface and powerful built-in features, Access is a good choice for nonprogrammers who want to get a database application up and running quickly.

Microsoft Corp.

Microsoft FoxPro for DOS
Microsoft FoxPro for Windows

BY JIM KORENTHAL

When Microsoft Corp. acquired Fox Software and the innovative Fox development team, devotees in the user community worried that Microsoft would let FoxPro stagnate while the Redmond giant's other database baby, Access, absorbed Fox's technology. But the $495 FoxPro, Version 2.5, is the program's strongest release yet.

FoxPro was always fast, but the new version is much faster, even on a busy network. Blazing speed isn't the only news, though. There are now two versions of FoxPro 2.5—one for DOS and one for Microsoft Windows—and the cross-platform expansion will continue. Microsoft is planning versions of FoxPro for Unix and the Macintosh (which will replace FoxBASE+ for those platforms, with the same kernel used throughout.

Far from stagnating, FoxPro immediately benefited from Microsoft's vast software store. For example, the Windows version takes advantage of DLLs found in other Microsoft products; SQL query results can be graphed using the same DLL found in Access, and the DLL that FoxPro uses to spell-check a text file or memo field is shared by Microsoft Excel. And Microsoft has now shifted the marketing focus for Access, positioning it as an excellent end-user tool with good programmability. FoxPro, then, with its rich development environment, is positioned as the company's premier tool for developers.

SUITABILITY TO TASK

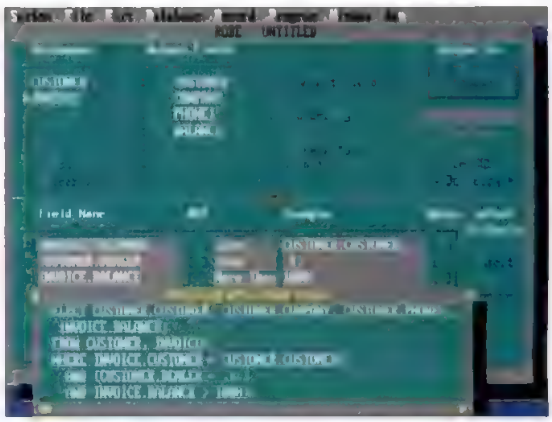
Microsoft FoxPro for DOS

	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	●	●
Professional development	●	●	●	●
Querying and reporting	●	●	●	●
Connectivity	●	●	○	○

WHAT MAKES IT SO QUICK?

Fox products achieved prominence in the database market through a combination of speed and close dBASE compatibility. Today, dBASE compatibility is not as important, but speed remains a central goal.

FoxPro has always been one of the fastest database systems. One reason is because the code is compiled rather than interpreted. Modified source code for programs, screens, reports, and so on is transparently compiled before it is run. Another reason for its speed is the extensive use of internal caches to avoid unnecessary disk access. Disk access is further minimized by the use of combined and compressed indexes (.CDX files).



Click "See SQL" in Microsoft FoxPro for DOS's RQBE screen to learn how to use the SQL SELECT statement quickly and painlessly.

Then there is FoxPro's Rushmore, a proprietary optimization technology that makes use of .CDX indexes behind the scenes. For example, "locate for customer=1234" would normally scan from the beginning of the database. Assuming a "customer" index was present, Rushmore would process this command as "set order to customer" and then "seek 1234."

It's worth noting that you cannot reap the full benefits of Rushmore optimization technology without some careful planning. For example, Rushmore will optimize NAME="JONES..." (a character-by-character comparison), but NAME=="JONES..." (a full, exact comparison, including padding spaces at the end) will not be optimized. The entire table will be scanned, even though when NAME is an eight-character field, they amount to the same comparison. The same phenomenon occurs when "exactly like" is selected in the RQBE dialog.

SUPERIOR DISPLAYS ARE PART OF OUR HERITAGE.

PC MAGAZINE EDITORS' CHOICE
June 30, 1992
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CIRCLE 283 ON READER SERVICE CARD

Also, Rushmore handles character-string keys better than numbers with two or more decimal places. For best results, you should index on the string equivalent of these floating-point keys.

FoxPro's SQL SELECT statement is well-integrated with Rushmore, yielding amazingly fast query times. SQL result sets are kept in memory whenever possible. For large result sets, FoxPro keeps record numbers in memory rather than the records themselves. (The records themselves can be retrieved quickly, thanks to Xbase's fixed .DBF format.) FoxPro assures that query results remain valid when the actual data is retrieved, even if records were changed between result-set construction and retrieval.

FoxPro for Windows' Screen Builder makes interface design easy. This version of the package adds several enhancements.

There are new elements that make Version 2.5 faster than its predecessors, but Microsoft is keeping the details secret. One improvement involves a new algorithm to determine the minimum information necessary to read from the server. This significantly reduces network traffic. And better use is made of information already in memory: Version 2.5 can avoid going to the disk or network in many cases where 2.0 couldn't.

INTERACTIVE TOOLS FOR END USERS

FoxPro's speed is not the only reason for its popularity; its easy-to-use interactive tools have also contributed to its appeal. The View Window can open databases, set relations, and inspect and modify their contents, all with a few mouse clicks. As you initiate each action, a Command Window shows programming statements that accomplish the same thing. It works in reverse, too; the View Window shows the changing database configuration when you type in the Command Window.

This learn-as-you-go approach is also used in FoxPro's RQBE tool. You can construct complex queries, complete with multiple table joins. RQBE then generates a SQL SELECT statement and sends the query results to a Browse Window, a printed report, a new database, an in-memory SQL cursor, or a graphing routine. Clicking on the See SQL button at any time will show the SELECT statement as it's constructed.

An automatic Application Generator lets you instantly create a multitable application with query, update, and reporting capabilities. But making any significant improvements to the application can require as much programming as building the application from scratch with the FoxPro Power Tools.

POWER TOOLS FOR DEVELOPING APPS

The FoxPro Power Tools include the Screen Builder, Menu Builder, Report Writer, and Cross-Platform Transporter (for moving between the DOS and Windows versions of FoxPro). The Project Manager ties all the pieces of an application together and generates .APP files (FoxPro applications) and .EXE files. The .EXE files, which are created with the $495 FoxPro Distribution Kit, can be either "self-contained" (run as standalone applications) or "compact" (run from within the FoxPro environment).

FoxPro's visual, object-oriented Screen Builder lets you quickly place and size objects such as text, fields, and push buttons in a window. You can combine windows to form complete applications. The DOS version lets you select objects through a menu. In the Windows version, the process is made easier by a graphical toolbox, but lines and boxes you create are sometimes mispositioned by a pixel or two, and data fields will be too short if you use capital letters. These problems can be easily corrected, though.

You specify an object's properties by double-clicking on the object. Dialog boxes let you select events, and a built-in editor lets you type instructions—"code snippets"—describing what to do when events occur. For example, to bypass embedded blanks in an address block, you could write a WHEN clause for each line that would move the cursor ahead if the previous line is blank.

The Screen Builder generates FoxPro source code from your screen layout and code snippets. Since source code for the Screen Builder is provided, you can actually modify the system to generate custom code or a new object type. For example, you could create a library that adds 3-D effects to objects.

The Report Writer makes it easy to create basic reports. You specify an object such as text, a database field, or a box. Then you drag the object to its proper "band"—title, detail, or summary. You can preview your report and easily tweak

PC MAGAZINE EDITORS' CHOICE

FACT FILE

Microsoft FoxPro 2.5 for DOS

Microsoft FoxPro 2.5 for Windows

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080

List price: $495 each.

Requires: *DOS version:* 286-based PC or better, 640K RAM, DOS 3.1 or later, mouse. *Windows version:* 386-based PC or better, 4MB RAM, Windows 3.x in 386 Enhanced mode, mouse; VGA monitor recommended.

In short: Microsoft FoxPro 2.5 blends a powerful and sophisticated development environment with a blazingly fast engine. The Screen Builder and end-user tools enhance productivity, and the cross-platform transporter makes it easy to port applications between the two versions.

479 ON READER SERVICE CARD

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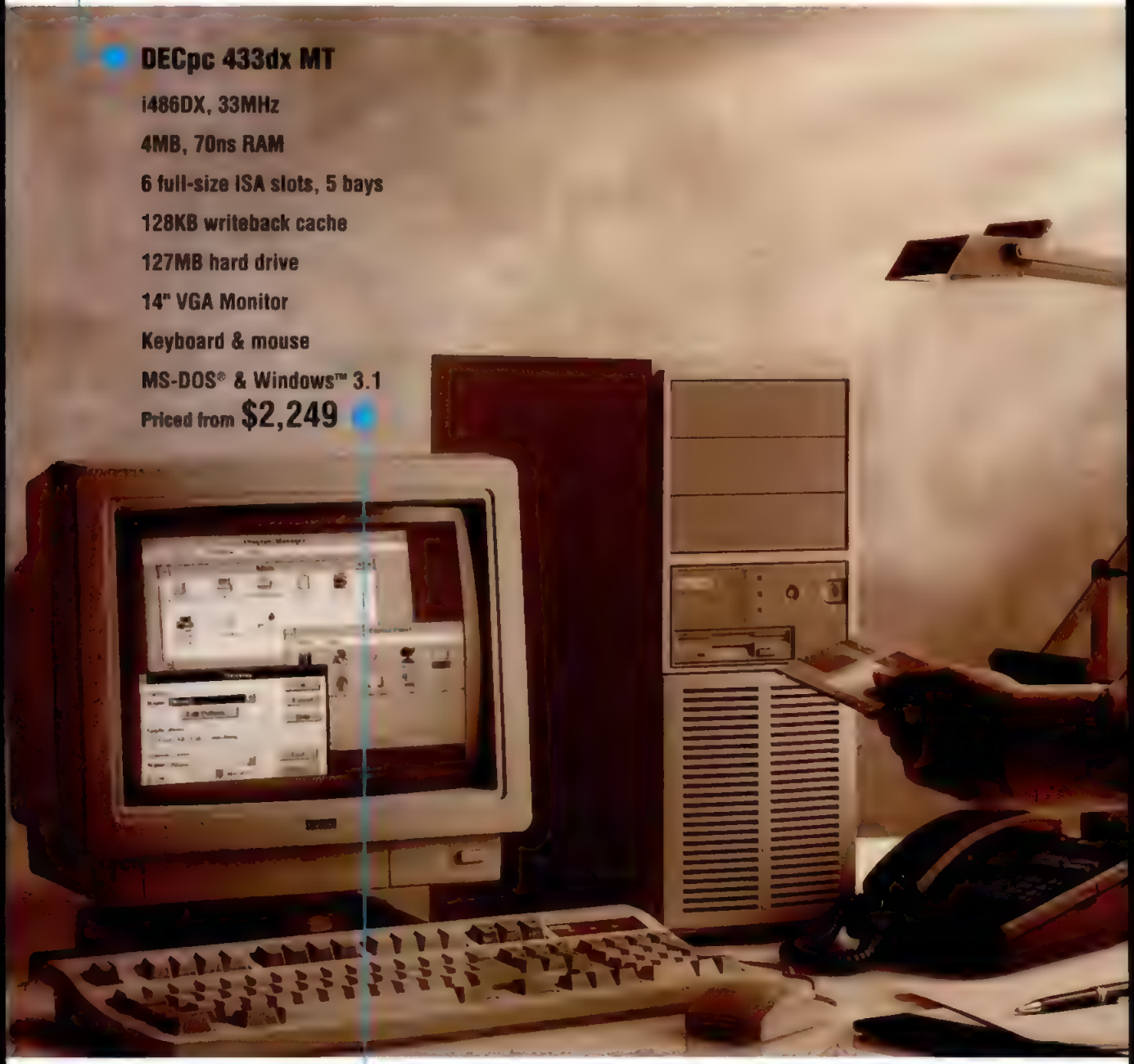

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PC Magazine, January 1993

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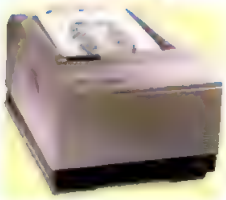

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it until it's just right. The Windows version provides a Report Generator toolbox that makes objects available by clicking on an icon, and adds a bitmapped object so you can easily add your company logo to the page header.

We anonymously called Microsoft on a Friday at 11:30 A.M., and our question was answered within 5 minutes.

For complex or highly customized reports, you must do some programming. User-defined functions can be used in output fields to provide advanced functionality, such as conditional page breaks that depend on the value of a variable.

If you need to go beyond the tools provided with FoxPro itself, there is the $495 Library Construction Kit (LCK); it was in beta at the time of this writing and should be released by the time you read this. The LCK provides everything you need to integrate Watcom C, Microsoft C, and assembly code into your applications. FoxPro 2.0 libraries must be regenerated for use with the DOS Version 2.5. The Windows version can call standard DLLs, but this can be tricky. An easier method is to create a special form of DLL called an FLL (FoxPro Link Library). You can call FLL functions within FoxPro as you would any other native function, and unlike DLLs, FLLs let you do callbacks.

NEW WITH VERSION 2.5

FoxPro for DOS includes both a 16-bit version, and a 32-bit extended version for 386-based PCs and better. The extended version is now DPMI-compliant, so it will run properly in a DOS box under Windows. The extended and Windows versions now allow up to 225 simultaneously open tables (increased from 25). This can greatly improve performance in complex applications where SQL SELECTS are accessing many tables behind the scenes.

FoxPro can't directly process foreign data or join tables stored in different formats as can Access. However, the APPEND FROM, COPY TO, IMPORT, and EXPORT commands have clauses that convert tables. Version 2.5 adds Microsoft Excel and Paradox to the list of supported formats.

A new preprocessor supports compile-time constants (#DEFINE, #UNDEF) and conditional compilation (#IF, #ELSEIF, #ENDIF). Conditional compilation lets you manage only one source-code base for multiple versions of an application (such as DOS and Windows versions), or debugging and production versions. An #INSERT directive allows inclusion of common code for screen or menu generation.

FOR WINDOWS ONLY

FoxPro offers a number of new features just for Windows. These include toolbars for all Power Tools, bitmap objects for the Screen Builder and Report Writer, a "GraphWizard" for on-the-fly graph specification in RQBE, and a spell-checker for text and memo fields.

The Windows version also lets you specify fonts and font sizes for Screen Builder–generated objects. A Tab Order dialog box makes it easier to rearrange on-screen objects. Quick Screen generates "instant screens" as a starting point for future modification. Quick Report performs a similar function in the Report Writer.

The FoxPro for Windows text editor supports drag-and-drop moving and copying, and can indent or outdent a block of text in a single operation. A new Windows status bar uses very little screen space but displays more information than does the DOS status bar.

FoxPro for Windows provides full DDE support, with the ability to act as both client and server. This means that data may be exchanged in both directions with other Windows applications. FoxPro can also be an OLE client by using the new "General" data type for the linked or embedded object.

GETTING HELP

FoxPro's documentation is thorough and clearly written, with a comprehensive master index. Technical support is available for the price of a phone call. We placed an anonymous call on a Friday at 11:30 A.M., and our question was answered within 5 minutes. Support is also available from the Fox forum on CompuServe (G CIS:FOXFORUM), a lively source of vendor and peer support.

FoxPro 2.5—whether for DOS or Windows—is a clear winner. Both versions offer spectacular performance in addition to a rich development environment. For database developers who are using other products but are interesting in trying FoxPro, Microsoft is offering a competitive upgrade price of $195, an offer that any serious database developer should find hard to refuse.

SUITABILITY TO TASK

Microsoft FoxPro for Windows

	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	●	●
Professional development	●	●	●	●
Querying and reporting	●	●	●	●
Connectivity	●	●	○	○

Borland International Inc.

Paradox for DOS

BY WILLIAM BEEM

If you have a need for speed, Borland's Paradox 4.0 for DOS will take good care of you. This $795 incarnation of Paradox includes a well-tuned engine that blazes through most database operations. Its extended memory management is now compliant with the DOS protected-mode interface standard, which allows it to run in protected mode under Microsoft Windows 3.*x* or OS/2 2.*x*.

The development environment has also been improved. Paradox's powerful new Application Workshop lets you quickly develop prototypes or full-blown applications that use pull-down menus and dialog boxes. And PAL (Paradox Application Language) has been enhanced to support event-driven programming methods.

FAST, FAST, FAST!

Borland International's claim that Paradox is the fastest database on the market may or may not be true, but there is no doubt that it's in the top echelon. Paradox consistently turned in excellent times on

Magic: *Worth the Steep Climb*

by Tony Pompili

Magic Software Enterprises Ltd.'s namesake product stands out as a flexible front-end database development package with a unique table-driven programming environment. Challenging to learn, Magic, Version 5.02, is most useful in a professional development environment for those less flustered by its lack of debugging tools and steep learning curve.

Magic ships as two separate pieces: a Toolkit development program ($800) and a Runtime user application ($1,500 per network). Unlike other relational database products in this review, Magic is primarily a front-end development package. But for those wishing to use it as a full database management product, it comes with Novell's Btrieve database engine, which lets you build databases immediately without requiring you to purchase additional gateways.

A FLEXIBLE FRONT-END

The power of Magic lies in its ability to access a wide variety of databases in disparate formats simultaneously. The company offers gateways to a variety of SQL databases, including Microsoft's SQL Server, Digital's DEC RMS, and Sybase's SQL Server. Magic also offers gateways to other popular databases including Informix C-ISM, DEC RDB, and Xbase. These optional gateways cost $500 each. For complex, corporate environments, the ability to access a variety of databases is a real plus. In multiuser environments, Magic automatically takes care of record locking. There are no explicit programming controls for this.

Magic uses tables to define every database application element; everything from field types to program file locations share the same definition structure.

Although the gateways provide a means for Magic to work with databases in their native formats, the program is limited in its ability to import databases. The basic package comes with only ASCII conversion capabilities; Magic can't even import .DBF files. You can, however, buy optional import drivers for $500 each.

Users access applications created with Magic's Toolkit development package with the company's Runtime package. Besides running existing applications, the Runtime module lets users create reports and basic queries with the product's query-by-example feature. Programming capabilities are limited to those provided in the Toolkit package.

Magic offers a CUA-compliant menu-driven interface with mouse support. Most of the table options are selected from pop-up pick lists to minimize typing. Developers can maintain iron-fist control over their applications by creating custom menus and choosing whether to display the menu bar when applications are run within the Runtime application.

Magic's table-oriented architecture lets developers create programs easily; application programmers need to learn only 13 operators.

The Toolkit and Runtime packages install in minutes. The package includes both 286 and 386 versions of the program to take advantage of extended memory. The Toolkit takes up only 2.3MB of hard disk space. Magic organizes all of the programs and table definitions into a single control file, making it relatively easy to transport from workstation to server or other locations.

TABLES EVERYWHERE

The key to working with Magic is buying into the program's unusual table-driven method of creating databases and programs. Building Magic applications is a process of filling in interrelated tables with appropriate commands, flags, and conditional statements.

Since programs, schema, and applications are generally all defined in tables referenced by other tables, Magic makes it simple to quickly change global values and parameters in a single record of a table and have it reflected throughout the application. For example, Magic lets you define not only fields, but field types. Once a Name field is defined it can be accessed by any database schema. Later, if the Name changes from 25 to 30 characters, you simply change the length once in the Field type table and the change is reflected in the schema definitions throughout the application.

To Magic, programs are just more ta-

bles. An object-oriented Program Tree helps you visually trace program nesting and maintenance. Program subroutines can be deleted directly from the tree. Described as code-free programming, the product uses only 13 main operators, such as Select and Link. In addition to the these Operations, however, are a series of interrelated tables and forms such as Expressions and Variable tables.

Tables are also used in Magic to define Magic-specific database schemes, which are used for all files regardless of format. Even .DBF files, for example, must have an associated Magic schema. A Magic schema replicates the native structure, including information on field name, type, and length. Unfortunately, however, there is no way to ask the Magic package to read the database structures and generate the Magic schema automatically. Conversion is a manual process of redefining fields and attributes.

Developers using Magic's Runtime application can maintain iron-fist control over their applications by creating custom menus.

PROGRAMMING, BUT NO DEBUGGER

Programming is required for everything from browsing through files to data entry to complex report generation. Magic comes with a Report Generator and QBE features that offer solid, but basic, capabilities. More complex operations require that you create some sort of Magic program.

Although there is a manual test feature so that you can check code for improper field or database references and other coding inaccuracies, Magic does not include a debugger, which the company says will slow down development and code execution. Error recovery is limited as well. Simple errors, such as a missing database name or accidentally using the wrong field name within a program, can cause Magic to crash back to the DOS prompt with almost no error message whatsoever.

Since Magic code is a bit scattered—some segments residing in a Program table, others in a Types table—it's difficult to get a big-picture view of the entire application just by glancing through the individual tables. Magic contains a documentation generator to let developers quickly print out all of the associated application tables and forms into a single ASCII document.

For the end user, the final application appears as a menu item on their Runtime opening screen. Developers have complete control over the applications that are listed on the menus as well as screen attributes. Besides choosing to display CUA menus, developers can selectively choose the actual menu items they want to be made available to their users.

Magic comes with a reference manual and tutorial. The tutorial is unusually long, which is to be expected since most developers will not have encountered the likes of Magic in their past database-development lives.

Magic is clearly oriented toward the professional, production-oriented development shop. It requires a fair amount of training to take advantage of the product's ability to quickly develop complex, transportable databases in multidatabase environments. Those looking for a quick-start database development system should look elsewhere. □

▶ **FACT FILE**

Magic 5.02

Magic Software Enterprises Inc., 1200 Main St., Irvine, CA 92714; 714-250-1720.

List price: *$800 for Toolkit developers package, $1,500 for network Runtime users package (including Btrieve gateway); additional gateways, $500.*

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our performance tests, occasionally trading the lead place with Microsoft FoxPro 2.5 for DOS.

The performance enhancements are due to a combination of enhanced locking algorithms, disk caching, index ordering, and more efficient memory allocations. With each query, Paradox examines its environment to choose the optimal method for data retrieval. As you might expect, Paradox prefers as much RAM as it can get to cache disk blocks.

SUITABILITY TO TASK

Paradox for DOS

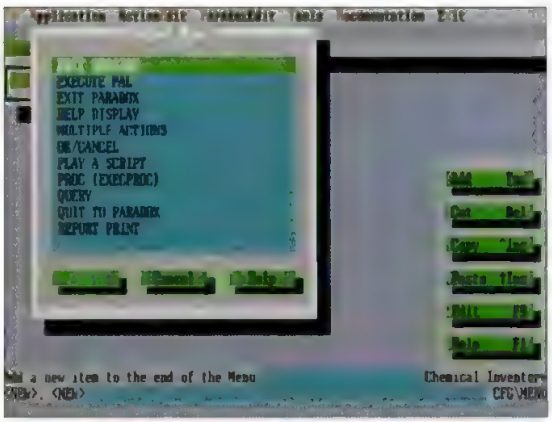
End-user applications	●	●	●	○
Professional development	●	●	●	○
Querying and reporting	●	●	●	●
Connectivity	●	●	○	○

Some PAL enhancements also contribute to the speed increase. Three new commands—SETBATCH, REPLACEFIELDS, and APPENDARRAY—allow applications to perform multiple operations with a single command. For example, the SETBATCH command lets the program temporarily gain exclusive rights to the database for executing a group of program statements. This speeds up program operations by locking everyone else out and reducing contention, but it has the potential for misuse.

Of course, you can't worry about speed until you get your data in the program. Paradox imports and exports Lotus 1-2-3 and Symphony files, Quattro Pro files, and even old VisiCalc files; Microsoft Excel spreadsheets aren't supported, but dBASE, .PFS, Reflex, and delimited ASCII text files are. Paradox can connect to SQL database servers with Paradox SQL Link (sold separately by Borland).

Although older versions of Paradox included FLIMPORT, a utility to import fixed-length text files, Version 4.0 doesn't. Borland will provide Paradox users with the old FLIMPORT from Version 3.5, but since it won't work with the new Paradox file format, a second conversion step is needed.

With Paradox, Borland finally included memo fields, but with a twist. Paradox memo fields have two parts: fixed length and overflow. The fixed-length



The Application Workshop in Paradox for DOS is excellent for prototyping or delivering applications.

portion can be from one to 255 bytes. Excess data is automatically stored in the overflow portion. The maximum size of a single memo is a plentiful 64MB. BLOBs, which store unformatted binary data, is another field type now supported. BLOB fields can hold bitmaps, audio files, or anything else you like, though you must provide your own utility to edit the special data.

A USER-FRIENDLY DESIGN

The user interface for Paradox has been updated to support multiple windows, pull-down menus, speed bars, and dialog boxes. There is mouse support, but not everywhere. For instance, you can't change directories when loading tables by pointing at a directory tree with the mouse; you have to type your path manually. The interface is still much cleaner than Version 3.5's, but an option lets users switch back to Version 3.5's interface if they prefer.

Paradox's QBE capability is still a strong product feature. Complex queries can be run against single or joined tables, and query images can be saved for later use. You can perform a variety of exact and inexact queries, and there is support for wildcards, data ranges, pattern searches, and logical conditions. Phonetic searches can be done with Paradox's "Like" operator.

Reporting with Paradox is very simple, but as one might expect from a DOS product, the results look less than inspired. Output is divided into the usual headers, footers, groups, and detail sections, but Paradox doesn't offer much in the way of font support or graphical output. The most you can do is send printer setup strings before and after printing your reports.

The graphing functions are similar—functional and easy to produce, but not presentation-quality. Still, Paradox lets you view your data in many graphical guises, including bar, pie, area, line, and marker charts. Bar charts can be rotated, stacked, or displayed in three dimensions.

LANGUAGE ENHANCEMENTS

The user-interface enhancements in the development environment, including pull-down menus and overlapping windows, can be used by PAL programmers in their applications. You can switch back to Version 3.5's style, if needed, with the SETUIMODE command. As welcome as this feature is, the big news in PAL enhancements is in the area of event-driven programming support.

Trappable events fall into four categories: mouse movements, keystrokes, system messages, and idle events that are generated at regular intervals. The new event-driven features are built into the GETEVENT, SHOWDIALOG, and WAIT commands. Additionally, Paradox provides a set of triggers that can be set off by specified user actions. For instance, the ARRIVEFIELD trigger could be used to display a specific help message for a data field, or to perform data verification before the user can edit the field.

Another interesting feature for developers is the new Dynamic Array. The traditional array has a predetermined size and is still supported in PAL, but this new type, added to supplement the event-driven features, has no specified size or limits. Dynamic arrays are useful for storing events trapped by GETEVENT for later processing. Events themselves take up more than a single field. For example, a mouse event has row and column information, and also an associated command such as MAXIMIZE. Dynamic arrays are referenced by a text string rather than by a numerical value. This makes it easier to associate values with their position in the array, but it means you can't traverse the array by incrementing a counter.

The new event-driven form of the WAIT command is distinguished from the old version by the way it is terminated. The WAIT/UNTIL block acts much like a READ statement in dBASE; the WAIT/ENDWAIT block activates the event-driven features and traps events such as keystrokes or mouse clicks. The dual use of the WAIT command could become confusing when multiple programmers are working on the same source code. A new command for the event-driven version of WAIT would have been a preferable solution.

The current debugger, like the one in the previous version, lets developers do little more than step through their code and check the contents of variables and arrays. It's surprising that the same company that makes the excellent Turbo Debugger can't provide a better debugger for PAL. At the very least, Paradox should support breakpoints.

A NEW APPLICATION BUILDER

Perhaps the most dramatic benefit for programmers is the Application Workshop, which offers much greater control than the Personal Programmer provided

FACT FILE

Paradox 4.0 for DOS

Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067-0001; 800-331-0877, 408-438-8400

List price: $795.

Requires: 286-based PC or better; 2MB RAM, 6MB hard disk space, CGA or higher-resolution video adapter; DOS 3.0 or later, or OS/2 2.x.

In short: Paradox 4.0 for DOS is a fast and flexible database system that easily handles heavy workloads. Its strong query-by-example function supports a broad variety of complex queries. Data storage is also flexible, you can store BLOB data types, which are useful for storing bitmaps and other nonstandard objects, in a Paradox database, along with more standard data. If speed is a priority in your high-traffic, multiuser environment, this contender is certainly worth a close look

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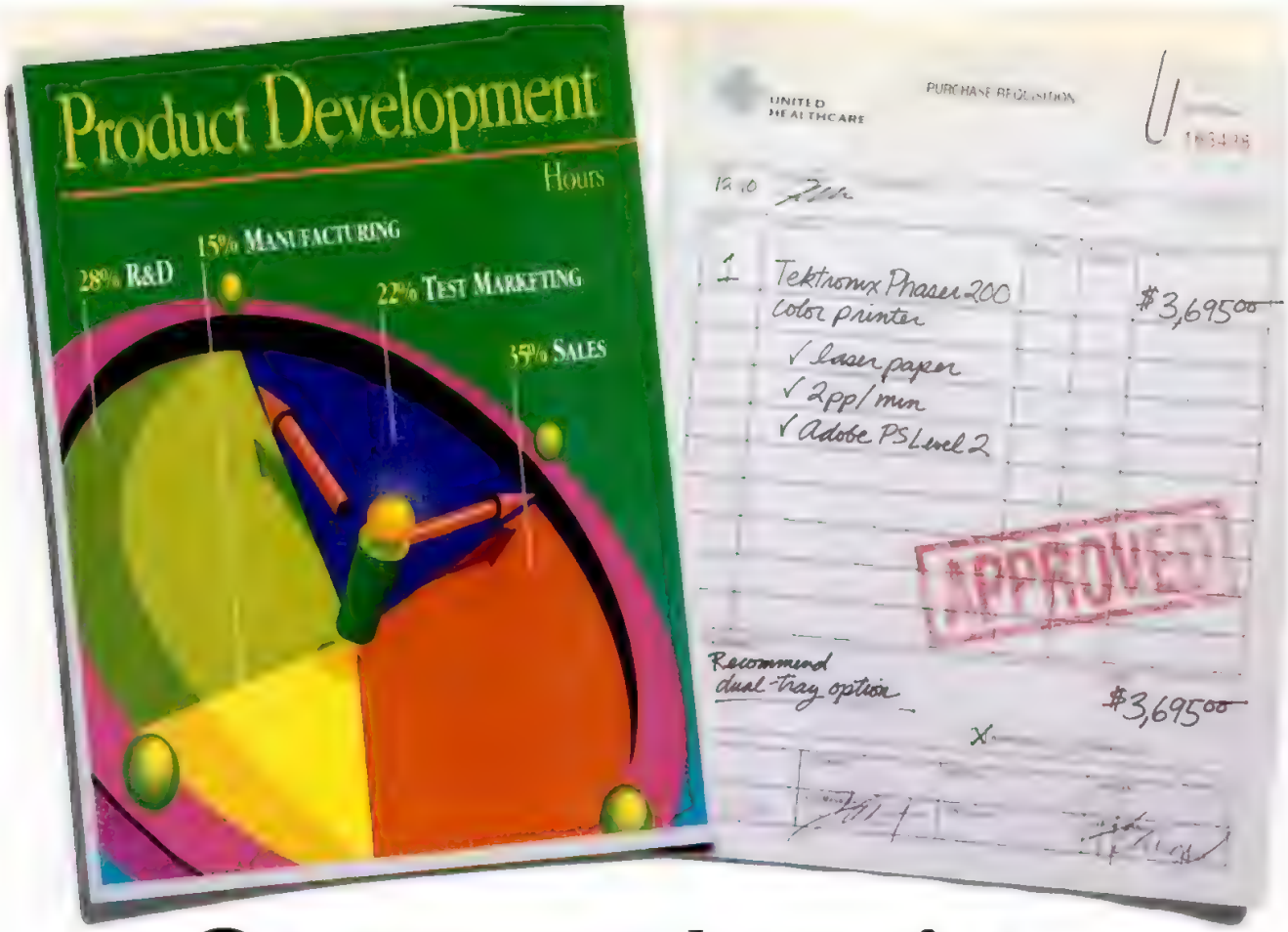

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with the previous version. The Application Workshop generates precompiled tokenized code that executes much more quickly, since it's interpreted at runtime. Designing and testing applications in the Workshop is fast and easy, and a plethora of options exist to tailor the application to your specific requirements.

The Application Workshop provides a set of optional, predefined procedures that can be modified with PAL code. SetUp Proc, for example, lets you run a procedure before a report prints: You might want to verify information, send specific printer strings, or edit a variable that will be used in the report. When the procedure generated by Application Workshop isn't sufficient, you can supplement it with your own PAL code.

Paradox for DOS's Application Workshop can dramatically reduce your development time.

The Application Workshop can dramatically reduce your development time. It's a fantastic prototyping tool and can provide a structure for program design.

A SOLID WORKHORSE

The documentation for Paradox is well-designed. A series of manuals divides the topics between the user interface, development techniques, and PAL reference. The reference manual lists the PAL commands in alphabetical order and provides excellent descriptions, examples, and cross-references to other commands.

Unlike Paradox for Windows, this version of Paradox doesn't require high-end hardware for reasonable performance. A 286-class machine with 2MB of RAM is the minimum configuration, though Paradox will recognize and take advantage of additional resources if they are there.

Paradox is designed for developers who need a quick, reliable database system with flexible data-querying features. Though the graphical output is not what you might get from a Windows product, Paradox performs well with large tables in high-volume multiuser environments.

Borland International Inc.

Paradox for Windows

BY WILLIAM BEEM

What do you get when you combine powerful data management with an interface that takes full advantage of Windows? The long answer is an intuitive, easy-to-use, object-oriented development environment, coupled with an unrivaled event-driven, object-oriented language. The short answer? Borland's $795 Paradox for Windows. Make no mistake, though; this is a whole new Paradox, from the ground up. Any relation to Paradox 4.0 for DOS is distant at best.

MANAGING DATA VISUALLY

With Paradox, everything is an object, so building an application is a simple matter of putting the right blocks together. Tables, reports, and queries are all objects. Even the gridlines on your browse table are objects.

Objects have properties and methods. The property of data in a table, for example, might include its font, color, and alignment. Methods are pieces of program code (in the case of Paradox, it's ObjectPAL code) that determine what the object does. The method tells the object how to respond to an event. Objects and methods are both reusable. Paradox's strong object orientation brings two important features of the package to the forefront: It is consistent, and it is visual.

SUITABILITY TO TASK

Paradox for Windows

	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	●	●
Professional development	●	●	●	○
Querying and reporting	●	●	●	●
Connectivity	●	●	●	○

Paradox's Database Desktop is the graphical user interface that manages the components—the objects—of your database application. The Desktop, itself an object, provides you with graphical tools that are intuitively easy to use, even when building complex applications.

One of Borland's signature tools plays an important part in database design: The Object Inspectors let you click the right mouse button on an object on the screen and view its underlying properties and methods. Leapfrogging other Borland products, Paradox's Object Inspectors have a new "pushpin" feature that lets them remain positioned on the desktop for easy access.

There are also powerful visual design tools for creating and editing tables, forms, and reports. You can graphically represent data relationships by selecting files and drawing links from one table's fields to another. Complex joins become as simple as pointing and clicking. There's a strong QBE capability, which lets you visually describe your query (which is also a reusable object), and then have that query automatically optimized for you.

Once you've defined a query, it is easy to define complex forms or reports based on the results. Paradox will automatically lay out the query fields on a form, even in one-to-many relationships. The "many" relations will be placed in a table format at the bottom of the form. Although the default forms are merely functional, you can modify the existing layout to produce presentation-quality output.

PC EDITORS' CHOICE

FACT FILE

Paradox for Windows
Borland International Inc.,
1800 Green Hills Rd., P.O. Box 660001,
Scotts Valley, CA 95067-0001;
800-331-0877, 408-438-8400

List price: $795; upgrade from previous version, $139.95.
Requires: 386-based PC or better, 4MB RAM, 20MB hard disk space, EGA or higher-resolution display, Microsoft Windows 3.x; mouse recommended.

In short: Paradox for Windows is a complete rewrite of the DOS product. Borland has gone a long way toward fully exploiting the object-oriented paradigm. Everything in Paradox for Windows is a reusable "object." Its visually-oriented interface is well-designed, and the product also boasts an engine-level data dictionary for enforcing referential integrity. However, this first release of Paradox for Windows is not especially speedy.

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February 23, 1993
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CA-dBFast: *Faster, More Visual*

by Joe Salemi

As we went to press, Version 2.0 of CA-dBFast, from Computer Associates (CA), was still in beta testing. The new version of this Microsoft Windows 3.*x*–based XBase compiler, which was due out by the end of March, fixes most of the bugs of the previous version and sports a number of significant new features and enhancements. Chief among them is the Visual Designer, a forms-based design tool and source-code generator. By laying out the different elements of the database on-screen, Visual Designer makes it easier for both programmers and nonprogrammers to create dBFast applications. CA expects to keep the price of Version 2.0 at $550, the same as earlier versions.

THE VISUAL DESIGNER

Visual Designer lets you create the data file structures, index files, and define relationships between the different files. Your application designs are presented visually on-screen in a tree format. This lets you see at a glance the calling relationships between the various menus, forms, and reports in your database.

You can customize the graphical user interfaces with pull-down menus, pop-up windows, and other standard Windows interface controls such as dialog boxes. Visual Designer also lets you create customized reports and mailing labels, including predefined Avery label sizes.

All of these elements are created through Visual Designer's *visual editors*. These give the programmer a WYSIWYG environment for creating the entire application. The menu editor, for example, lets you build menus interactively; that is, you can insert, delete, and rearrange menu items while viewing the actual active menu bar. Likewise, dBFast's screen editor is a WYSIWYG forms generator. Simply select the resizable window objects from the toolbar and place them on your form.

Visual Designer works with what CA calls the *data dictionary*, a central list of all the different elements (data files, indexes, and so on) that make up a database. The data dictionary becomes part of the application environment; it helps the programmer modify and maintain any or all of the files that make up the database.

When you finish designing an application, Visual Designer automatically generates the source code for it and creates any new or modified data and index files that might be needed. It lets you compile the source code as is, using the normal dBFast compiler, or customize it with your own functions and routines before compiling. Programs created with the Visual Designer can be compiled and distributed to client sites without license fees.

THE PROGRAMMING ENVIRONMENT

Though it has the ability to browse data files, dBFast 2.0 is aimed primarily at XBase programmers who want to create Windows-based database applications. It still uses the dBASE-compatible .DBF file format and supports dBASE III Plus indexing schemes and files. Over 200 programming functions are built in, and developers can create their own user-defined functions (UDFs). Each program or module can use a maximum of 128K RAM split evenly between compiled code and data space. You can combine a maximum of 24 programs and modules into a complete application.

The heart of dBFast remains the XBase compiler. XBase programs (.PRG) are standard ASCII text; you can create them using either the built-in editor or your own preferred editor. Most programmers will want to use the internal editor; it provides an icon-based toolbar and a number of facilities, such as pick lists of different statements and functions, that make it easier to write programs.

Once you've created the source code, you can compile it to an overlay (.OVR) file. The program can then be run from within the dBFast Workbench (CA's name for the main program screen), or directly from Windows using the DBFNRUN runtime application. You can also link the overlay with the runtime libraries to create a standalone program that can be run without the whole dBFast environment. Here again, no royalties or licensing fees are required to distribute executable programs you build with the environment.

The compiler includes a built-in debugger option. When you turn the debugger on, dBFast automatically loads the source code into the built-in editor; dBFast highlights any statements that cause a runtime error. The debugger also lets you set watch points and breakpoints, step through the program, or just monitor the values of different program variables while the program executes.

Unfortunately, there is no way to compile and run a program in one step. You have the choice of saving just the source code or saving and compiling it in one step. But you have to choose a different menu option or use the runtime program to execute the resulting overlay.

A NEW REPORT WRITER

The CA-RET module, a Windows-based report writer included with dBFast, supports a number of report styles such as tabular reports, forms, merge letters, and mailing labels. CA-RET lets you include graphics as part of a report, though it supports only bitmap (.BMP) files at this time. CA-RET's Query Builder uses a form of SQL to create a Report Input Table from one or more database files, then uses the input table as the basis for the report. It also contains more than 40 functions that let you include calcula-

tions as part of the report.

Reports created by CA-RET can run outside of the report designer with the CA-RET runtime module. As with the other components, programmers can distribute the reports and runtime module without having to pay any licensing fees.

IMPROVED PERFORMANCE

Version 2.0 fixes most of the bugs that were reported in the current released version, and performance seems to have improved as well. Though we encountered some problems running the beta package in some of our informal performance tests, the tests we were able to run showed performance gains over the old release.

Visual Designer makes it easier for both programmers and nonprogrammers to create dBFast apps.

CA-dBFast 2.0 represents a significant improvement over previous versions, and database developers may find Visual Designer an appealing way to quickly create complex XBase applications that run under Windows. But dBFast is no longer the only Windows-based XBase system, and only time will tell how it measures up against Microsoft's FoxPro for Windows and Borland's Paradox for Windows. □

▶ FACT FILE

CA-dBFast, Version 2.0
Computer Associates International, Inc., One Computer Associates Plaza, Islandia, NY 11788-7000; 516-342-5224.
List price: *$550 (projected)*
Requires: 386-based PC or better, 1MB hard disk space, Windows 3.0 or later, DOS 3.0 or later.
Circle 486 on reader service card

A rich set of charting options are also provided, and it is easy to combine data and graphics into one report.

The core of Paradox is Borland's InterBase engine, which uses ODAPI (Borland's Open Data application programming interface) to provide native access to files in different formats. Files in different formats can be transparently linked for multifile queries. ODAPI drivers for Paradox and dBASE are shipped with the product. These are the only drivers available at this time, though more are planned.

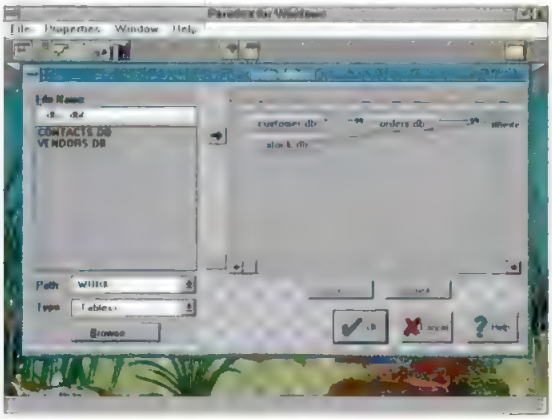
ODAPI is not a least-common-denominator solution. For instance, .DBF files managed by Paradox can include expressions in their index files, which they can't ordinarily. Even Paradox files get additional benefits not present in the DOS product, such as referential integrity and table lookup links.

The referential integrity option ensures that a field or group of fields in a child table refer to an index key of the parent table. When referential integrity checking is turned on, Paradox will accept only values in the child table that already exist in the parent table's index. We didn't use this feature during testing, since it exacts some overhead.

Paradox saves referential integrity links in a file with the table's name and a .VAL extension. An index of the referential integrity fields is created when you save the definition file. The Strict Referential Integrity option prevents the DOS versions of the product, which don't support referential integrity, from opening tables with these definitions. Referential integrity can be defined only between Paradox tables, and the tables must be located in the same directory.

Since Paradox supports .DBF files directly, there is no import/export facility for them. This can present a problem if you want to use the referential integrity features. However, you can move data from Paradox to .DBF format by using the environment's COPY facility, or by performing an "insert query," which stores the results of a query in a file you specify, rather than in an answer table.

Support for different data types has never been better. Paradox gives you the ability to use traditional memo fields, as well as memo fields that maintain rich text formatting. Graphics fields can contain any of the popular Windows and DOS graphics formats, such as .PCX, .BMP, .EPS, .GIF, and .TIF. You can even directly store BLOBs, making Paradox ideal for next-generation multimedia databases with sound and video.



The Data Model in Paradox for Windows lets you link files for reports or queries by drawing a line from one table to another.

Paradox can import and export data from most popular spreadsheets and delimited text forms as well. Unlike the DOS product, there is also support for importing the fixed-length files commonly produced by mainframes. Paradox creates new Paradox tables to store imported files; you can't directly import them into previously defined tables. This must be done in a second step, where data is transferred from the temporary import table to your own tables.

PROGRAMMING WITH OBJECTPAL

Paradox developers will find quite a few changes between PAL (Paradox Application Language) and Paradox's new ObjectPAL. While ObjectPAL is largely a superset of PAL, it is much more of an event-driven, object-oriented language; ObjectPAL programs are written by attaching code snippets to interface objects, much like in Microsoft Visual Basic. Each object has a set of built-in methods to modify its behavior, and developers can create their own methods to handle specific situations. Hence, the interface components are incompatible; Borland does not provide a conversion utility.

Also, some features of PAL don't exist within ObjectPAL. For example, you cannot use commands to access menu options such as file import. With Paradox for Windows, you must import files through the menus.

The Paradox debugger is an improvement over the DOS product, which only allows you to step through your code. Paradox developers can trace program executions, set breakpoints, and inspect variables. The debugger can step into nested levels of code, or step over sections that you know are bug-free. You can also select which built-in methods you want to trace or ignore.

The ObjectPAL documentation lists objects alphabetically by operational group, such as Strings, Tables, UIOBjects, or Reports. While the explanations are clear, and helpful examples are provided, this organization makes it hard to locate a method if you don't know which operational group owns it. Paradox includes an on-line language help facility, but it shows only the calling syntax for the methods. You must rely on the manuals for examples and descriptions of the language functions.

SPEED SACRIFICE

What Borland has sacrificed, at least in Version 1.0, is speed. It finished near the back of the pack in most all our tests, though its performance was on a par with the other Windows-based products (with the exception of the blazingly quick FoxPro for Windows). Borland expects to have Paradox better optimized and running faster in Version 2.

Also, plan on dedicating some resources to Paradox. The product requires at least 20MB of free hard disk space and 4MB of RAM, but don't be miserly. You will need at least 8MB of RAM for decent performance.

Paradox is a truly exciting Windows database. It can act as an OLE client, it fully supports DDE, you can use it to call DLLs, and its object orientation offers great promise as a quick and painless tool for database development. Microsoft Access may have a more attractive user interface, but Paradox's well-implemented, consistent, and highly visual application of objects makes this a powerful database for every type of user.

Microrim Inc.

R:BASE

BY STAN LESZYNSKI

R:BASE is like your favorite office chair: What matters more than how it looks is the way you settle into it, get comfortable, and get a lot of work done. R:BASE ($795) may not be the prettiest, most full-featured product in this roundup, but it is powerful enough to meet most needs and its menu-driven interface lets you quickly build serious applications.

Version 4.0 adds enhanced memory management, row-level locking, increased table and column limits, and a debugger. And R:BASE 4.0 is the first PC database to run in 32-bit protected mode, using 32-bit addressing on 386 and 486 systems to eliminate code swapping. There is also a 32-bit version of R:BASE for OS/2, but it does not take advantage of OS/2's multithreading capability.

THE RELATIONAL MODEL

Whereas most file/server products store databases as a collection of disconnected tables, index files, and—in some cases—files with relational information, R:BASE takes a different approach. Each database consists of three files. The first, which contains the data dictionary, includes information on the structure of the entire database: names and attributes of the "columns" (R:BASE terminology for fields), which columns are indexed, the relationships between the tables, pointers to the first and last records, and other information. The second file is the actual data, and the third is the index file.

This structure, which approximates the classic relational model more closely than do Xbase systems, has several advantages. It is more secure than an Xbase system. Since data rules are enforced at the engine level rather than within forms, they apply whether data is entered via a form, an import, or directly into a table. Multitable updates are possible because R:BASE knows where a particular column is located in all the tables.

R:BASE relies on SQL for data manipulation tasks, providing full support for ANSI Level 2 SQL. Developers working in a multiplatform environment will also appreciate R:BASE's ability to unload a table's structure (with or without data) as a series of standard SQL statements that can be read by other SQL database programs.

R:BASE also supplies a basic programming language for creating applications around the SQL commands. Common constructs like WHILE loops, IF statements, and variables are supported, and the language can be enhanced with user-defined functions written in C. However, the language lacks array variables and file I/O statements and is slow to execute because there is no compiler. It is not a language designed for sophisticated programming.

INSTANT DATABASES AND APPLICATIONS

R:BASE provides an interactive command line prompt for typing SQL statements, but most users will prefer to use the excellent menu system rather than typing commands directly. R:BASE's Create/Modify menu is particularly well-designed: It conveniently groups table, column, rule, and security definitions together. Tables are built by means of a grid that defines data types, indexing, and descriptive comments for each column. Further, R:BASE uses its centralized data

FACT FILE

R:BASE, Version 4.0a
Microrim Inc., 15395 SE 30th Pl., Bellevue, WA 98007; 206-649-9500

List price: Single-user version, $795; five-user LAN Pack, $995.
Requires: 286-based PC or better (386-based PC or better recommended), 640K RAM (4MB recommended), 2.5MB extended or expanded memory, DOS 3.1 or later.

In short: R:BASE, Version 4.0a, is a mature and stable database system that closely follows the relational model, providing engine-level relational integrity. Its well-integrated menu system and outstanding SQL implementation provide an excellent balance between usability and power. Though R:BASE is not especially fast and its programming language is somewhat limited, it is a well-rounded product that is suitable for all but the most demanding applications.

483 ON READER SERVICE CARD

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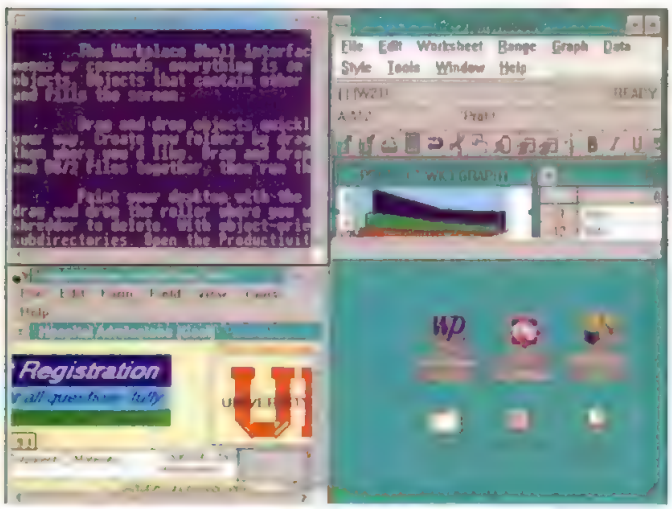
Drag a file object from one folder and drop it in another to move it. Drag a folder object and drop it on the shredder to delete it. Drag a file object and drop it on the printer to print it. In the OS/2 Workplace Shell,™ common procedures become intuitive clicks of a mouse.



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–Runs DOS, Windows and OS/2 applications.
–Pre-emptive multitasking.
–OS/2 Crash Protection.™
Advanced 32-bit architecture.
–Fully exploits 386SX processors and above.

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working within the 640K barrier, take advantage of more of your computer's memory.

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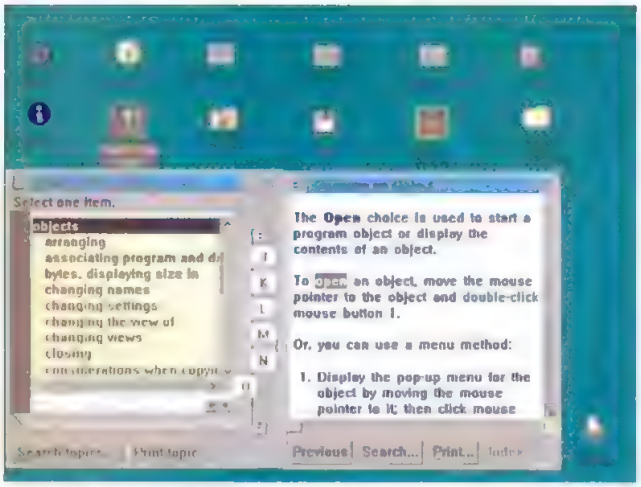
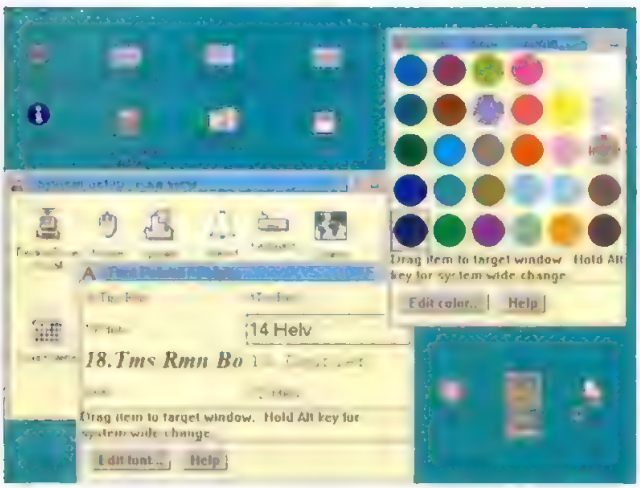


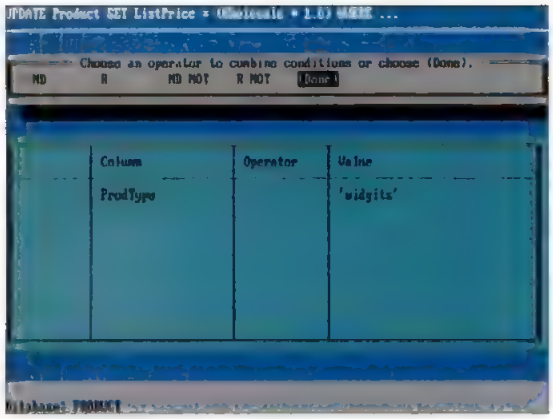
In the Workplace Shell, everything appears as an object. It's a simple, intuitive, more efficient way to work.

With built-in networking features, OS/2 was designed to excel in both standalone and connected environments.



Organize and customize your desktop to look and work the way you want it to.

You can set alarms to remind you of events with the Alarms function in the Productivity folder.



R:BASE's PROMPT system helps you build commands interactively. It's an excellent learning tool for both the product itself and SQL.

dictionary to require that all the columns in a database with a given name are also of the same data type, a good habit.

R:BASE supports a rich variety of column types. Besides such standard types as text and currency, R:BASE allows computed columns (for example, Amount = Quantity * Price), whose values are stored in the database and can be indexed. However, since R:BASE does not directly support multicolumn keys, some applications may require you to create a computed column that serves only as an index—a waste of disk space. R:BASE also has an autonumbering feature for generating sequential numbers (useful for invoices, for example).

A standard grid layout supports QBE. Menus let you build, modify, and save queries, and the mouse-enabled query designer prompts you through adding row selection criteria. Query results are shown in the R:BASE table browser.

Browsing and editing table data in R:BASE is painless, though not as powerful as it might be. You can add a sort order or query to the table; change the size, location, or color of any column; compute column statistics; and cut and paste column data. However, you cannot copy, paste, or delete multiple rows; you cannot search for or replace specific strings within a column; you cannot undo a change after you have moved the cursor off the record; and the browse grid does not show the number of records and your relative position.

R:BASE comes with a good tutorial on general database concepts as well as on the specific features of R:BASE. The on-line help, however, is disappointing. While there is context-sensitive help, R:BASE lacks indexes, topical cross-references, and examples. Help for database settings and programming functions—the most complicated features of the product—is minimal and hard to locate.

APPLICATION DESIGN

The powerful form-design feature has all but the most advanced features. R:BASE has a Quick form option, but Quick forms are read-only for multitable views. If you forego the Quick form, you can produce multitable forms with cascading updates and deletes, variables, form preview, and custom menus. Field-level triggers are available to launch program code on entry or exit, and a field can have a one- or two-column pop-up menu from which to select values. Form design, however, could be made easier with a cut-and-paste capability, better drawing tools, and the ability to drag fields with the mouse.

Report design, similar to form design, includes a Quick report option. Reports can have breakpoints (groups), variables, and headers and footers; all these options are presented to the user in an easily understood fashion. However, R:BASE has not yet incorporated such features as embedded subreports, which are now common in other products. A separate report design mode handles mailing labels and includes 14 templates for standard label sizes.

Forms and reports can be linked into applications with Application EXPRESS, a code generator that can drastically shorten development time. Application EXPRESS prompts you through the creation of a menu system with standard database functions attached to menu items. Advanced users can modify the generated code to meet special needs. The built-in editor is usable but cries out for improvements such as syntax checking and split-screen support.

MORE POWERFUL THAN OTHERS...

Experienced developers can take advantage of R:BASE's sophisticated engine. It allows concurrency control for multiuser applications by means of a configurable wait queue and refresh interval; in addition, it protects users from a deadly embrace (two users waiting infinitely to update the same record). Developers can tailor locking mechanisms, set table locks from code, and write transactions that use COMMIT and ROLLBACK—all of which are sophisticated features for a file/server product. A new debugger helps users find problems in their code by providing single-step execution, breakpoints, and watch variables. Developers can distribute R:BASE applications via a runtime module, which is priced at $150 for a five-copy version or $595 for an unlimited license.

R:BASE imports and exports common data formats, giving you more control of the data transfers than do many other products. For example, when you are specifying the layout of a fixed-width ASCII import file, you can preview as many records as you like and change the import field definitions using real data.

SUITABILITY TO TASK

R:BASE	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	●	○
Professional development	●	●	●	○
Querying and reporting	●	●	●	○
Connectivity	●	●	●	○

You can export data from a saved view definition, sort the exported data, and apply a conditional statement (WHERE clause) to the exported data. If you prefer not to import dBASE data directly into R:BASE, you can attach dBASE files from the menu system and use them as if they were native R:BASE tables, referencing them in forms, reports, applications, and views.

...BUT A LACKLUSTER PERFORMER

R:BASE's 32-bit addressing makes for a snappy user interface, but the advantages do not yet filter down into R:BASE's multiuser database operations, which were among the slowest in our test group. Loading and reporting were also sluggish. That R:BASE could be so slow even with its new row-level (versus page-level) locking feature suggests that R:BASE

still runs on a very old code base and is due for an overhaul.

R:BASE failed to complete our multiuser update test due to a bug in the tested release that caused posting of data to fail when two or more users tried to update the same record from program code (although concurrency worked correctly from data-entry forms). Microrim has subsequently devised and demonstrated a patch to fix the problem and has made it available to customers via its bulletin board and product support group.

While other database companies have been distracted by the twin frenzies of merger-mania and the stampede to Windows, Microrim has focused on delivering timely, reliable upgrades to their strong core product. R:BASE still needs faster performance, a better browser, a more robust program editor, improved reporting, and better on-line help.

Despite these shortcomings, however, R:BASE's relational model, solid SQL, excellent data integrity and rule validation, helpful menu system, and application generator, all make it a well-rounded product. Like that favorite chair, once you slip into R:BASE you won't be in any hurry to slip back out.

Software Publishing Corp.

Superbase

BY ALFRED POOR

The Windows database market has received a lot of attention in recent months, thanks to the arrival of new products from powerhouses like Microsoft and Borland. One difference between these products and Superbase ($795), from Software Publishing Corp., is that Superbase has been around for years. The company recently released Version 2.0 of the package, which has a lot to offer end users and developers alike.

The new release brings some significant improvements over previous versions of the product. Many new features, such as the configurable icon bar, query by example, and quick menus enhance ease of use for end users. Developers, too, will find handy new capabilities: Superbase now includes a macro recorder that allows code generation from the quick report and query by example features as well as from the custom menu, forms, and report designer modules. There is an improved debugger, not to mention support for OLE and gateways to a variety of SQL servers.

POWERFUL AND EASY

Superbase makes good use of the Windows graphical user interface with dialog boxes, menus, and toolbars. In fact, you can create sophisticated applications without a single line of programming. To create a database you simply name the file and define the fields. Dialog boxes make it easy to add sophisticated validation procedures and features for editing entries. There are check boxes for attributes such as nonstored (virtual), required, and read-only. For each field, you can assign a data type, define a display format, create custom help messages and comments, assign default values, define a calculation, and create validation rules.

You can also choose whether or not an index is to be created for that field. Superbase can use only a single field per index; to create a multiple-field index, you must use calculations to concatenate the contents of the fields and create a new field. Since Superbase can index on a virtual field, this does not exact a storage penalty.

You also have the option of assigning most of the field attributes in a form instead of within the file definition, which gives you greater flexibility. Forms are used to enter, edit, and view data. You create a form using the Form Designer program (which also is used as the Report Designer.)

Form Designer is essentially a simple paint program. The built-in drawing tools allow you to place lines, text labels, and simple graphics images on your forms, as well as insert images from disk files. Superbase supports 15 different bitmapped and vector image formats, including 24-bit color; it can scale, crop, and convert color to gray or dithered images.

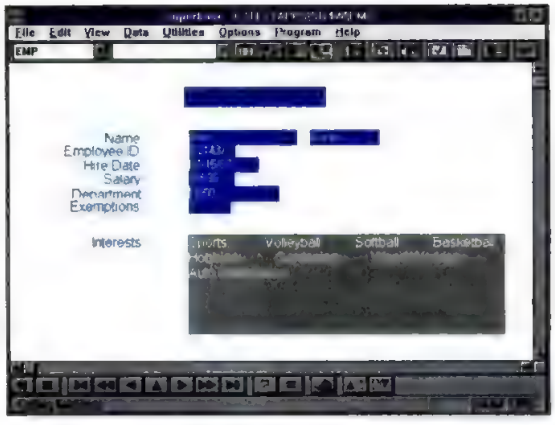
You can also place fields on your forms, defining the way that the field's contents will appear in terms of font, size, color, and format. If your field contains a filename, you can retrieve the contents of external files. For example, you could use this feature to include employee photographs in a personnel database. Superbase supports both DDE and OLE, so you can link and embed objects from other Windows applications.

Superbase uses the same designer program to create formatted reports and also includes a Quick Report feature. Quick Reports are tabular: you can select which records are to be used by defining a filter, and there are options for order, grouping, and headers. You can also define calculations, such as summary statistics by group or the database as a whole.

LINKING TABLES TOGETHER

Superbase does have some limited ability to maintain referential integrity of related files, but only through the use of data entry forms that link files. The result is that relationships are recognized only if they are displayed as part of the active form. This is a weakness in the product's design that makes it possible to delete or alter parent records without guaranteeing that the links to related records will be maintained.

You can create multiple-line windows



Superbase makes it easy to create data entry screens with different fonts and effects.

SUITABILITY TO TASK

Superbase	POOR	FAIR	GOOD	EXCELLENT
End-user applications	●	●	●	○
Professional development	●	●	●	●
Querying and reporting	●	●	●	○
Connectivity	●	●	●	○

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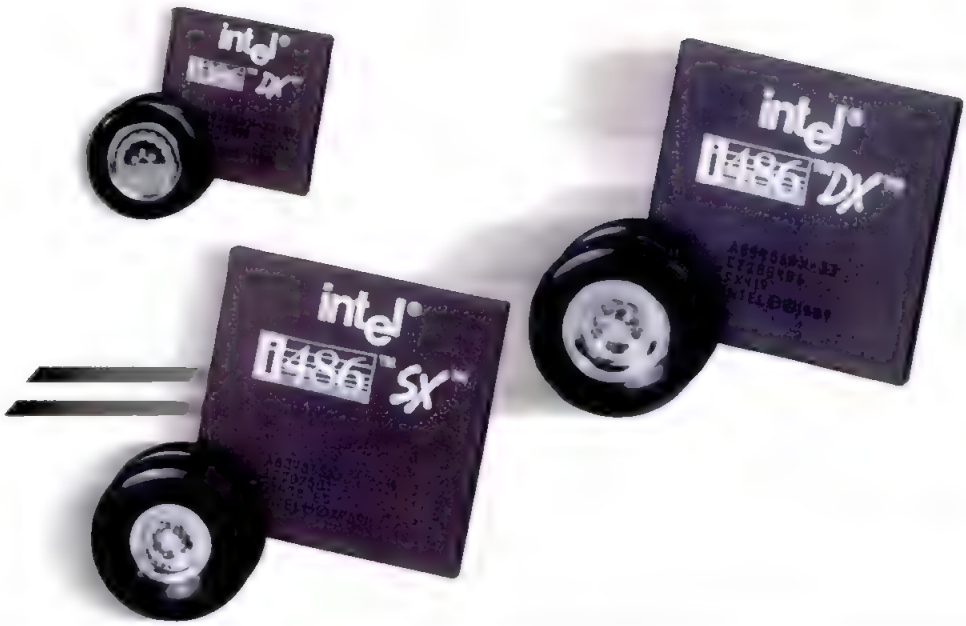

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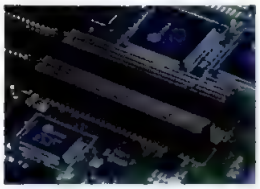
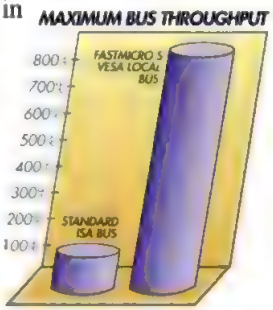
Settle for everything! While a few computer companies give you VESA local bus and even fewer give you a VESA standard monitor, FastMicro includes both!



VESA Standard Local Bus!

Why settle for slow Windows video? FastMicro includes a high performance Windows accelerator combined with a VESA standard local bus!

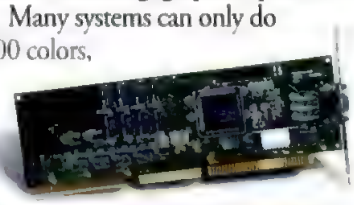
Why is Local Bus faster? The i486 is a high speed 32 bit processor. Video cards plug into a slot in your PC, called a bus connector. The standard PC bus was designed for an 8 MHz 286, therefore it's confined to 8 MHz and 16 bit. FastMicro's VESA Local Bus runs up to 33MHz and 32 bit. Turn on your 486/Pro2 and watch Windows scream!



Why VESA? VESA Local Bus is a standard, unlike a proprietary local bus. You can upgrade your system in the future with third party VESA standard local bus peripherals. With your 486/Pro2 from FastMicro, you're not locked in.

Plus True Color Video!

No video card delivers more! FastMicro gives you the maximum number of colors possible for scanning, graphics, presentations and desktop publishing. Many systems can only do 256 colors, some can do 32,000 colors, FastMicro takes you to the limit with 16.7 million colors maximum! Plus FastMicro has all the latest VESA video options.



FastMicro Combines VESA Local Bus Performance with Windows Acceleration & over 16 Million Colors!

VESA Standard Refresh Rates at 640x480, 800x600, & 1024x768!

VESA Standard Flicker-Free Monitor!

Non-Interlaced monitors are not created equal. A non-interlaced monitor with less than a VESA standard refresh rate will flicker at high resolution modes! The resolution is the number of pixels (or 'dots') on the screen, the refresh rate is the speed in which the monitor redraws the screen. Don't be fooled.

Your new 486/Pro2 system from FastMicro includes VESA standard refresh rates at supported resolutions! Compare and don't settle for less, if other systems don't say it, they won't do it!

20% Larger Display with Edge-to-Edge Video!

In addition to eliminating annoying flicker when running in high resolution modes, FastMicro doesn't make you look at tiny characters either! Our new VESA standard display includes Edge-To-Edge video! 14" monitors are not created equal. You see, 14" is strictly the tube size, not the display area. FastMicro 486/Pro monitors are user adjustable for width, height, and position - just set to your preference and forget it.

Standard Non-Interlaced Monitors

FastMicro Edge-To-Edge Video!

You get more useable screen area than many 15" monitors. Edge-To-Edge video is really a lifesaver when running at 800x600 or 1024x768 Super VGA modes!

Extra Ram & Storage

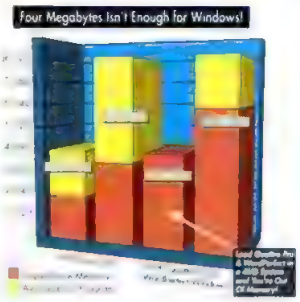
Some companies give you a 120, 170, or 200 Megabyte drive and four megabytes of memory, FastMicro gives you much more.

Western Digital 256Mb Drive.

WESTERN DIGITAL

It's like getting an extra 44MB for free! FastMicro now includes Western Digital's Caviar AC2250. It combines a 256MB capacity, less than 13ms average seek time and an adaptive multi-segmented 64K cache. Add a data transfer rate of 6MB/Sec. and a mean time between failures of 250,000 hours and you'll have years of worry-free high performance. You can also choose Western Digital's AC2340 for $150 extra. It has the same specifications, except for a 341MB capacity.

Eight Megabytes of Memory!



Running Windows? Don't run out of memory! When Windows runs low on memory, it starts using your hard drive like memory. Memory is 200+ times faster than a hard drive - don't get caught short! FastMicro includes a full eight megabytes of RAM in every 486/Pro system.

Inverted Back

1. Follow instructions on the other side

GbsSlipBack-001B

Back

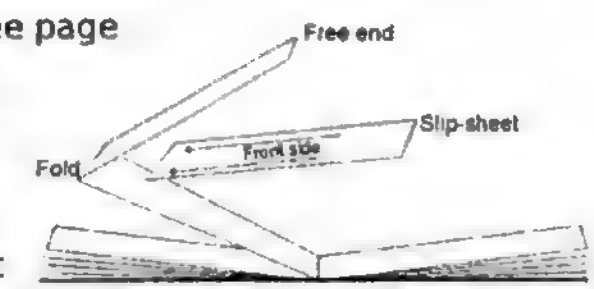
1. Follow instructions on the other side

Folded edge of the page

GbsSlipSheet-001

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet

1. Open the foldout page
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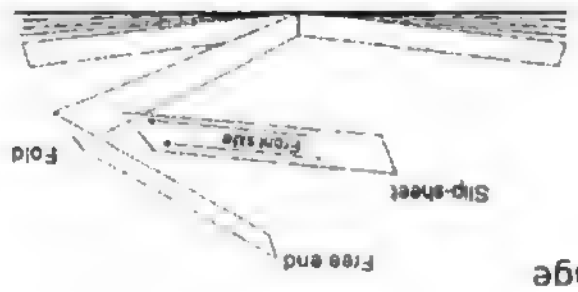
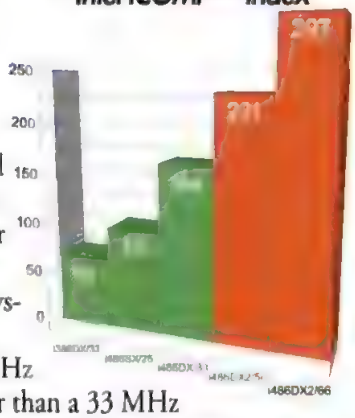
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



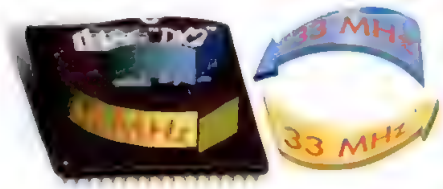
Double Your Power with FastMicro's 486/Pro2!

Imagine! 40% to 80% faster than a 33MHz 486DX



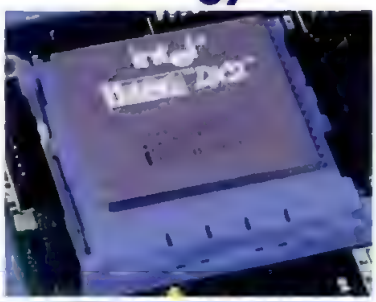
Want the fastest 486 performance? Get a FastMicro 486/Pro2 with an Intel i486DX2. A 50 MHz i486DX2 is 39% faster than a 33 MHz i486DX in the same system, but it costs only $100 more. The 66MHz i486DX2 is 79% faster than a 33 MHz i486DX! Actual impact on total system performance will vary depending on your type of application.

How is a DX2 different from a standard DX? It utilizes Intel's speed doubler technology. The PC is divided into two parts: external functions (outside the 486 microprocessor) and internal functions (inside the 486 microprocessor). The external functions operate at half the i486DX2's speed (33MHz external for a 66MHz i486DX2). The internal functions operate twice as fast. An internal 'bus interface' controls the internal and external speed differences.

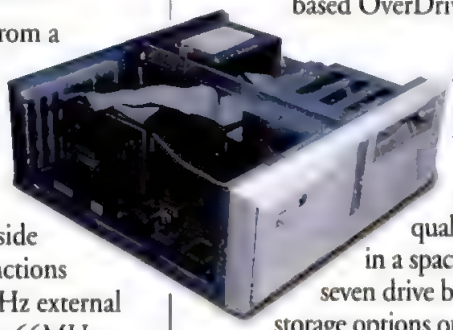


Is the system really much faster if the processor has to wait for the rest of the system? Absolutely, because the central part of the system runs twice as fast as it normally would. It's like if airplanes flew twice as fast. The in-flight portion would take half as long, but you & your bags would still get on and off the plane at the regular rate!

Upgrade to Pentium Based Overdrive Technology!



Not only do you get a highest performance 486 technology today, but you can upgrade it tomorrow! Put a FastMicro 486/Pro2 system on your desk and when you're ready for even more power, you can pop in an Intel OverDrive™ processor and boost performance even more! FastMicro makes the upgrade easy with an advanced 238 Pin ZIF (Zero Insertion Force) socket. You just change some system settings then lift the lever and upgrade your processor. Notice the extra row of pins around the i486DX2? Those are reserved for a future upgrade to Pentium™ based OverDrive™ technology.

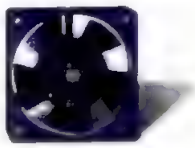


Advanced Case Design

Our desktop case is uniquely engineered to provide the highest quality and maximum expandability in a space saving design. It has a total of seven drive bays to accommodate all of the storage options our customers tell us they want to be able to add in the future. It also has extra protection against electrical interference, unlike the weaker systems others sell. It also includes a power supply that's U.L. recognized.

Dual Intelligent Cooling Fans!

Every desktop FastMicro PC comes with dual cooling fans. It has a main fan that's quieter than fans in ordinary PCs - plus it includes a special second fan that comes on only when the system gets warm. A cooler system lasts much longer - a concern particularly when using a harder working i486DX2.



...But We Couldn't Keep It Still Long Enough!

on a form that displays data from related records from another file; you can then add, edit, or delete those related records on the same screen. These windows are of a fixed size, but scroll bars will appear automatically if there are more lines to display than will fit in the window. You can also create dialog boxes and pick lists that make it easy to look up values based on the contents of other files during data entry.

The QBE feature is easy to use and full-featured. You can select fields in different tables, link them using examples, and set selection criteria. Calculations and a full range of Boolean operators can be used to define your selection criteria. There are wildcard and string search functions, as well as support for Soundex matches in case you aren't sure how to spell the string you want to locate. You can use queries to insert, update, and delete batches of records at one time, then store the queries for later use. You can even use QBE to generate code that can be incorporated into other Superbase procedures. You can sort or group query results and output them to a window, a full-screen display, printer, disk file, new Superbase database file, or even the Windows Clipboard.

PROGRAMMING WITH SUPERBASE

Just about every menu-driven feature can be used to generate code in the Superbase language (SBL), making for a very flat learning curve. There is also a keystroke macro recorder that produces commented SBL code, so you can simply walk through your application using the interactive commands while recording the keystrokes and then use the resulting macro as the foundation for a process. Menus and toolbars can also be completely customized, either through menu options or code.

The command set and syntax of SBL closely resembles that of Visual Basic. While the database selection syntax is similar—but not identical—to SQL syntax, its similarity to other widely used tools helps users to become proficient quickly. Since SBL is a tokenized, interpreted language, it is not as fast as a compiled language but it is faster than one that must be completely interpreted as it is being executed. SBL performs a syntax check of your code as you enter it. You can also encrypt your code to protect your work. If you need functions or features that aren't included in Superbase, you can use any other language you want to create additional procedures, as long as it can be compiled into a DLL for Windows.

There are other features that developers will appreciate. The built-in editor allows as many as 50 files to be open at once. The debugging utility includes breakpoints and supports variable speed or single-step execution. And the program automatically moves subroutines in and out of memory as needed.

You need a runtime module to be able to run Superbase applications. The Developer Edition of Superbase has a list price of $1,395. It consists of a complete Superbase package that includes the SQL Library upgrade ($795 if purchased separately) and a royalty-free, unlimited runtime license.

SOME SECURITY LOOPHOLES

Unlike Xbase packages, the records in a Superbase file are stored in a variable-length record format, which makes for smaller data files. Numeric values are stored in a binary form, but text fields are stored as ASCII values. This results in a security weakness in that you can use the DOS TYPE command to view the contents of a Superbase data file. There is no way to encrypt the data, and users can easily by-pass security features built into Superbase applications.

Superbase does offer some data security features, but these fall short compared with the ones offered by some other packages. Security is implemented through passwords tied to the user name and is applied at the field level, but there are only three built-in security levels. You can create your own security systems by coding procedures, but this takes programming time and effort.

Superbase will run on any Windows-supported network and comes with easy-to-use locking schemes that do not rely on the network itself. You choose the type of access and locking when you open a data file, so you do not have to write tedious code segments to lock and unlock for every record access. There are commands to support explicit locking of individual records if you need them.

Software Publishing provides a range of support options. All users receive free technical support for the first 90 days after purchase. After that terms vary; end-user support starts at $99 per year, and developer support starts at $299 per year. The company provides online assistance through CompuServe and a private BBS, plus there is toll-free, no-charge access to a fax-back and a recorded voice system of technical tips and information.

SLUGGISH PERFORMANCE

The biggest weakness of Superbase is its performance. In our test suite, it was in the second half of the field in just about every test. Consequently, it is not the best choice for applications where the fastest speed is required or where there will be an extremely heavy load on the system.

The strength of Superbase is its ease of use. It makes good use of Windows and gives you access to most of its features without any programming. Should you need to develop more sophisticated database applications, the programming tools are powerful enough to let you do it. Superbase is not the new kid on the Windows database block, but it's well worth a fresh look. □

FACT FILE

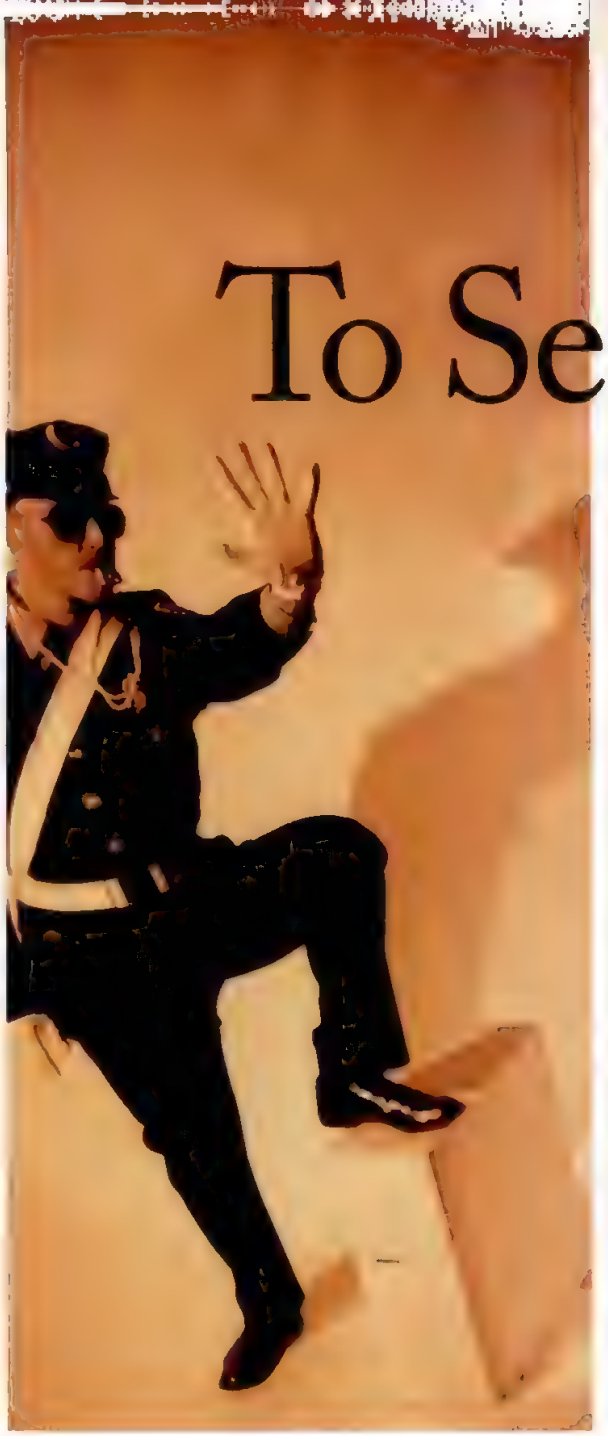
Superbase, Version 2.0
Software Publishing Corp., 3165 Kifer Rd., P.O. Box 54983, Santa Clara, CA 95056-0983; 800-772-2225, 408-986-8000

List price: $795
Requires: 286-based PC or better, 640K RAM, 5MB hard disk space, 1.3MB extended or expanded memory, DOS 3.3 or later, Microsoft Windows 3.x, mouse. (386-based PC or better, 4MB RAM, 7MB hard disk space, DOS 5.0, Windows 3.1, VGA or higher-resolution display recommended.)
In short: Although not as speedy as some of the other reviewed multiuser programs, Superbase 2.0 is still an attractive package. It makes excellent use of the Microsoft Windows interface, and can be used effectively with little or no programming. If you need a Windows multiuser database program that is easy to use but hard to outgrow, Superbase deserves a close look.
477 ON READER SERVICE CARD

REMEMBER LIFE BEFORE MICROSOFT WINDOWS? NOW YOU KNOW HOW YOUR PRINTER FEELS.

FILE SERVERS

To Serve and Protect



The power to serve up files comes in a variety of shapes and sizes. ZD Labs puts nine single-processor file servers through their paces.

Don't be fooled. Some vendors want you to believe that you need expensive, specialized hardware if you buy a file server. It's simply not true.

Others may tell you that the type of processor in a file server isn't all that important. This too is a canard. Still others will want you to believe that any PC-on-its-side can be a file server. While this might be closer to the truth, you may not be satisfied with what you get.

And so it goes in the mad search for a file server that's right for you. At a time when more users are looking for cost-effective computing platforms, vendors are rushing in with a new crop of PCs ready to handle the challenge.

THE MARKET

Bounded by more complex servers above and mildly reconfigured desktops below, the sys-

by David Greenfield

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Photograph by Scott Wippermann

HIGHLIGHTS

File Servers

OVERALL PERFORMANCE for this server class dropped off sharply after we loaded the machines with more than 60 concurrent clients on ZD Labs' tests with 512K files, and between 20 and 40 concurrent clients on our tests with 1MB files. These configurations simulate the stress a much larger network would put on a server, because only a fraction of the computers on an average network are actually accessing the server at any given time.

FAULT-TOLERANCE features come in many flavors, and vendors can't seem to agree on which are best. All the machines tested supported some version of RAID (Redundant Array of Inexpensive Disks).

MODULAR CPU CARDS make it easy to step up to the next level of microprocessor without resorting to major work on the motherboard. Some of the tested servers could be readily upgraded with a Pentium chip.

DUAL-PROCESSOR capability was supported only by the Acer and ALR machines, but additional vendors should be offering multiprocessor server units in the very near future.

REMOTE NOTIFICATION, while supported on only two of the nine tested servers, is steadily evolving into a standard server feature. With this feature, which requires a modem, the server can alert the network supervisor via telephone or beeper if there is a major system problem.

A SIMPLE RAM UPGRADE is the least expensive—yet a very effective—method of gaining better performance from your server. Maximum system RAM capacity for the servers in this roundup ranged from 110MB to 384MB.

SECURITY apparently was not a major concern of most of the vendors. Most machines offered only minimal security: locks for the keyboard and drive door. Additional security measures, such as keeping the server itself in a locked office, may be useful.

DISK DRIVE EXPANSION space was easy to come by in most of the tested servers. Five of the nine tested servers offered ten or more drive bays.

PRICES for this server class have remained fairly steady, even though main processors and other features have been vastly improved since our March 17, 1992 roundup of 486/33-based servers. Last year's servers (as configured for our tests) ranged in price from just over $5,000 to just under $18,000. This does not count IBM, which had a $25,000 entry last year and wasn't represented in this roundup. This year's roundup offered prices ranging from just over $6,000 to just under $17,000.

QUALITY SUPPORT and fast on-site service are necessities with servers, because a single problem can keep dozens of otherwise productive users idle. Some machines, such as the AST and the Dell units, were solidly built and impressively easy to service.

tems we examined fall into the middle of the network file server market. Broadly speaking, file servers can be divided into four categories:

- At the very low end are fast, unadulterated PCs used as servers. These are desktop PCs and are no different than the systems that power users might place on their desktops and rely on for local computing. A 486DX/50 with 32MB of RAM and a 2GB hard disk array would usually set you back about $6,500.
- Next up on the file server ladder are the PCs-on-the-side. These machines are desktop PCs that are simply repackaged as tower systems. Other than the fact that they can stand on their sides, there is little value that is added. The $6,449 Northgate Elegance ZXP Server, for example, is simply a mild derivative of its desktop machines.
- The machines we reviewed fall into a more specific third category. They are tower systems, and the best of them have redesigned interiors for greater room and better accessibility. All the systems reviewed used an EISA I/O bus; the prices for these machines in their tested configurations averaged $11,500.
- Although some could be upgraded, the platforms we evaluated lack the costly multiprocessing architecture, error checking and correcting (ECC) memory, and other sophisticated reliability and manageability features available in the fourth, most complex category in this hierarchy: top-end super servers.

These machines, however, cost at least $10,000 more and can run as much as $80,000, and are typically called upon to process applications as well as to send file data to network workstations.

What are you missing by not spending an extra $10,000 or more? For one, the tested servers were effective on our tests only until they had to handle 60 or so concurrent clients (workstations that are requesting information simultaneously).

This number is substantially less than the user load handled by super-server platforms, which can handle about 75 or more concurrent clients. Typically, the number of concurrent clients will be far less than the total number of stations on a given network, and the exact number of clients will vary depending on the load generated by each user.

Our Contributors: DAVID GREENFIELD is a senior editor of *PC Magazine*. OLIVER RIST is a staff writer of *PC Magazine*. BRUCE BROWN and WINN L. ROSCH are contributing editors. NICK STAM is the hardware technical director of PC Magazine Labs. DAVID FRERICHS is a project leader at ZD Labs and supervised testing of the servers. BRIAN NADEL was the associate editor in charge of this story.

In addition to the limit on concurrent clients, with midlevel servers you also lack data integrity–promoting features such as ECC memory and parity checking on the bus, which are provided by super servers. These features prevent rare bit errors from corrupting data.

Now, interestingly enough, with the emergence of Novell's NetWare SFT III, one of the older arguments for super servers—a system's fault tolerance—can become less powerful. SFT III enables network managers to configure redundant servers. If one server suffers from a hardware error, SFT III will automatically reroute connections, switching clients to the backup server.

If one server suffers a hardware error, NetWare SFT III will reroute connections, switching clients to the backup server.

REVIEWED AND REVEALED

We reviewed nine servers: Acer America Corp.'s AcerFrame 1000/50, the ALR ProVEISA VM 4/66d, the AST Premium SE 4/66d, the Compaq ProSignia 486DX2/66, the Dell 466SE/DSA PowerLine Server, Digital Equipment Corp.'s DECpc 450ST, Hewlett-Packard's HP Vectra 486/66ST PC Server, the NEC PowerMate Express 486DX2/66, and Zenith Data Systems' ZDS Z-Server 450DE. These machines contain the minimum hardware you'll need to set up an efficient server.

We had started by inviting the top 15 vendors of dedicated file servers (not reconfigured desktop systems) to participate in this test. Several, including Netframe, Parallan, Sequent, and Tricord Systems, concentrate on the higher and more expensive end of this market. The most significant absence, however, is IBM, which will introduce a new server by the time you read this review.

Company officials said that IBM was between computing generations, with the Server 85/95 about to be augmented by a server that could handle multiprocessing. The new IBM system will use the proprietary Micro Channel bus that theoretically should offer some benefit over an EISA bus.

What the nine high-end file servers that we tested offer the prospective buyer are industry-standard platforms backed with lots of memory and disk space.

All of the servers were equipped with between 1.2GB and 2.4GB of storage, except for the Dell 466SE/DSA PowerLine Server, which came with a 4GB disk array. To level the playing field, we asked vendors to configure their servers with four Madge Smart 16/4 EISA Ringnode Token-Ring adapters unless the manufacturer specified and shipped its preferred interface card.

The Madge card is one of the fastest EISA Token-Ring adapters on the market today, and walked away with our Editors' Choice last year (see "Token-Ring Adapters for the PC: Poised for an Explosion," *PC Magazine*, October 13, 1992).

Six vendors accepted our offer to use Madge cards while three declined, delivering their products preconfigured with their own adapters. Compaq, DEC, and HP chose to send network cards from NetFlex, Proteon Technology Corp., and Olicom USA, respectively.

As for processors, we sought systems with the vendors' choice of Intel's two top CPUs: three units used a 486DX/50 while the remaining six used a 486DX2/66. All of the machines, except those from Compaq and DEC, offered at least RAID 1 support, which allows mirroring of data (for additional information, see "RAID Technology: How Safe and How Inexpensive?").

Finally, list price for the tested configurations ranged from just under $6,300 for NEC's machine to $16,850 for the AST server.

Over the course of two weeks we put these systems through the paces with 22-hour individual workouts. The testing sequence varied both client load and file size while testing for maximum throughput and CPU utilization. All told, we transferred a total of 3 terabytes (TB) of data across our simulated network during testing in early January; prices are current as of late February.

So what did we learn? More than anything else, we found that the functionality

Suitability to Task

The Compaq ProSignia 486DX2/66 excelled in three of our four Suitability to Task categories, an indication of a good all-around file server.

Scalability involves a server system's potential for expansion. We base the rating on flash BIOS availability, disk capacity, maximum cache RAM, maximum system and motherboard RAM, multiprocessor capabilities, open expansion slots, power-supply wattage, processor upgradability, and total half-height drive bays. The servers we judged *excellent* came with flash BIOS, had drive bays and slots to spare, and supported dual-processor capability.

Product Name	SUITABILITY TO TASK
Scalability	POOR
Security/fault tolerance	FAIR
NIC throughput	GOOD
CPU utilization	EXCELLENT

The **security/fault tolerance** rating reflects the system's reliability and data-protection features. To earn an *excellent* rating, a server needed to support most of the following: BIOS password security, front-panel security, a high-wattage power supply, "hot" drive replacement, keyboard security, optional redundant controllers, problem-notification software, remote-notification features (these require a modem), and temperature sensors.

Many of the newer server-management features were not supported by the servers when we tested them but should be available by the time this review is published.

NIC throughput (network interface card throughput) is a measure of the amount of data a network adapter can transmit over the network. The higher the throughput, the better the rating. For this task, we asked for Madge network cards—although we did not require them—because of their high bandwidth.

CPU utilization measures overall stress on a server. An excellent rating went to servers that can manage complex requests for data while maintaining low CPU utilization. A server that can handle 60 clients with 50 percent CPU utilization is rated higher than one with 75 percent CPU utilization at the same client load.

Also Includes a Double Software Bonus Too!

Start with Windows & a Genuine Microsoft Mouse!

With FastMicro 486/Pro2 systems you get more! Of course you get the latest versions of Microsoft DOS and Windows preinstalled. But unlike most of our competitors, we include a true Microsoft mouse, not the lowest price mouse we could find.

Take Two - Get up to $700 Worth of Software

The best computer deserves the best software and FastMicro includes some of today's hottest software at no extra charge! Choose any two of the following titles and you'll get the latest versions ready to run. Some products come in special FastMicro packaging and manuals (retail boxes shown) and you get full manufacturer support.

WordPerfect for Windows

WordPerfect is the #1 selling word processing software and the Windows version is loaded with features. It includes the ability to create & edit tables, equations, lists and graphics. You can even edit graphics created with other programs! Plus, it works with your WordPerfect for DOS files and uses familiar WordPerfect commands so your transition to Windows is easy.

PC Tools 8.0

The latest version of the top selling utility software! PC Tools 8.0 adds an all new DOS desktop with integrated application menu & manager, file viewer & manager, scheduler, and desk accessories. You also get Central Point's award-winning backup and a hot new version of Anti-Virus. PC Tools also includes DiskFix, FileFix, Undelete, Unformat, Disk Edit, Defragmenter, Cache and more! Central Point Commute lets you remotely run Windows or DOS applications and you get new RamBoost Memory Optimizer too!

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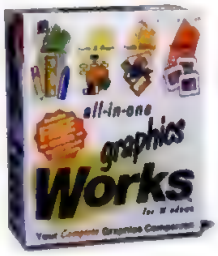
Quattro Pro for Windows

"Quattro Pro for Windows is worth the wait" proclaims PC Magazine. QPW uses spreadsheet notebooks to easily organize your spreadsheets. Click your right mouse button and Object Inspectors lets you change attributes instantly! Speedbars give you those one-click shortcuts that change depending on what you're working on! Interface Builder lets you build applications without programming. "QPW comes with a separate Database Desktop application -a beautifully designed query-by-example tool," says PC Magazine. "QPW's graphs are gorgeous and include rotatable 3-D types as well as options to adorn them." Need we add more?

Paradox 4.0

Paradox is the most advanced relational database ever created for the PC. Now it's the fastest. For first time users or application developers, Paradox provides the ease of use and power you need! New Application Workshop, Paradox's application generator, lets you easily develop custom applications. Paradox also has automatic multiuser support and is network ready. Combine this with the full suite of development tools and SQL connectivity and Paradox is the database of choice!

Graphics Works for Windows



With five applications in one, Graphics Works from Micrografx gives you complete graphic tools for Windows. Includes Windows Draw! - the hot selling package that lets you create graphics compatible with your other Windows programs. It also includes new Photo Magic! - the photo editing software that comes with hundreds of photos you can use as-is or modify and use in your documents (plus you'll have photo realism on-screen with FastMicro's true color video). You get a charting tool and the leading organization charting software for Windows. Plus you get a bonus CD with over 1,000 photos and 10,000 pieces of clip art you can use as-is or customize with Graphics Works!

Why settle for less?
FastMicro includes the real thing: a Microsoft Mouse.

ZEOS® 486 EISA. Better Than Ever!

NEW FEATURES. HOT NEW PRICES!

PC Magazine called it "Outstanding." "...best on our tests." "...both surprisingly useable and affordable." Now we're calling it *better than ever*...and we know you'll agree!

It's the new, improved ZEOS 486 EISA. We've taken our powerful Editors' Choice EISA and added the features you've been craving: standard 256K cache, a monster 452MB SCSI hard drive, incredible upgradability, EISA SCSI caching controller for the fastest access to the info on your hard drive, flash BIOS, super VGA...plus a whole lot more. Everything you want for now...and need for tomorrow!

HOT NEW PRICES
486DX-33 $3495
486DX2-50 $3595
486DX2-66 $3695
INCLUDES 2MB CACHING CONTROLLER!

THE POWER OF EISA.

If you're running applications with heavy file access, you know to insist on EISA. And if you need a system that can grow with the territory, insist on a ZEOS.

Check out the specs on the right. The new ZEOS EISA's Zero Insertion Force (ZIF) upgrade socket makes upgrading your system easy. There's room enough to grow–all the way to the powerful performance of the OverDrive processor based on Intel's Pentium architecture. Plus, the six 32-bit EISA expansion slots will accept your 8-bit and 16-bit cards and run them without a hitch.

DETAILS MAKE THE DIFFERENCE.

With the ZEOS EISA, details make the difference. Like two cooling fans to help prolong the life of your system's components. A high-capacity power supply with built-in surge suppression. An easy-on-the-eyes non-interlaced SVGA color monitor. A Diamond SpeedStar 24X video card that offers over 16 million colors! A Microsoft Mouse, Windows and DOS. And that's not all.

READERS' CHOICE FOR SERVICE AND RELIABILITY.

In *PC Magazine's* recent Service and Reliability issue, ZEOS was the only vendor to receive the "Excellent Service and Reliability" rating for both desktops *and* notebooks!

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of a given unit depends more on its configuration than on any inherent difference in the server itself.

The Compaq ProSignia 486DX2/66, for instance, was able to achieve midrange performance, without ever stressing the CPU. On the other hand, Dell's 466SE/DSA PowerLine Server stood out for its strong performance on individual tests.

The Dell's performance numbers were skewed due to its larger disk subsystem capacity, which can access the same amount of data in less time than smaller subsystems (for more information, see "What the Numbers Mean").

In addition, though it wasn't our Editors' Choice, the AST system stood out for its thoughtful and flexible chassis design. On the downside, however, we found that the DECpc, the HP Vectra, and the NEC PowerMate were the underachievers of the group in terms of all-around performance. Acer and ALR proved to be midrange performers (see "Editors' Choice"). Overall, our top performer was the Z-Server, which often set the pace for this group.

EDITORS' CHOICE

- **ZDS Z-Server 450DE**

Servers are the most complex and expensive inhabitants of the PC world. They have to be. Their role is to act as a traffic light controlling the flow of data to an increasingly networked world. For many businesses today, keeping employees connected is a matter of financial life and death. A server that flawlessly doles out files regardless of whether the user is next door or across town is the absolute minimum expectation. So it is not surprising that we saw a variety of approaches aimed at increasing reliability and performance in our examination of the industry's best high-end file servers.

Over two weeks of testing, we gave each file server a strenuous electronic workout that approximated the severe demands users put on network connections. We exercised systems over a continuous 23-hour period, moving a total of three terabytes of data across our 120-client network. While testing these nine dedicated servers, we were much more demanding than most purchasers of this class of machine; all clients were active, high-load network participants rather than the more typical situation in which most workstations are occasional or light users. This kind of testing procedure can result in an overly pessimistic appraisal of most installations, but it serves to highlight shortcomings in design and implementation. The bottom line is that, unlike EPA fuel-economy testing, we feel that with a similar-size network, you're likely to see better performance than what we experienced.

MANY PLAYERS, ONE STAND-OUT

On the whole, each server performed well, and each had its strengths and weaknesses. The AcerFrame 1000/50 had the most potent disk array, while the HP Vectra 486/66ST PC Server came with a VESA local-bus video subsystem. For the budget-minded, the ALR ProVEISA VM 4/66d and DECpc 450ST came with the lowest base price tags, and the NEC PowerMate Express 486DX2/66 had the lowest fully-configured price. At the other extreme, the AST Premium SE 4/66d came with the largest price tag. The Compaq ProSignia 486DX2/66 and the Dell 466SE/DSA PowerLine Server had remote notification of a server failure, a feature that is rapidly becoming essential.

While we tested many servers that will satisfy most system managers, only the ZDS Z-Server 450DE puts it all together at a very attractive price. This system performed 10 to 15 percent faster than average on our I/O throughput tests, and cost $2,000 less than average.

SLEDS, RAID AND THE LIKE

Perhaps the biggest differences in terms of performance came about as a result of how the vendors configured their hard disk storage. It has long been shown that the best way to speed up a file server is to add more spindles (drives).

With many drives in a disk subsystem, sequential operations can benefit from parallel data transfers, and random operations can benefit from the multiple drives independently seeking and transferring data. Making sure that this adds up to superior performance depends upon the sophistication of the controller and driver software.

Many of the test units used RAID subsystems (redundant array of inexpensive disks), which specifies several different techniques for spreading data across multiple drives. RAID lets servers issue simultaneous requests for data to multiple drives. By multiplexing requests in this fashion, the time to retrieve a file can be significantly decreased, depending on the file's organization on the disk.

In addition, with the RAID specifications you get increased reliability. Techniques for achieving increased reliability range from complete disk mirroring, where the data is duplicated on an additional drive, to using complex error-detection and error-correction algorithms in a drive array.

Drive arrays are created using code that is either implemented in the network operating system or in hardware shipped with the drive array. Though many vendors claim that hardware drive arrays are indeed more effective than software drive arrays, we did not find any evidence of this during our testing.

Some vendors take a different approach to the whole question of disk drives with single large expensive disks (SLEDs). These massive disks may contain the space of an entire drive array.

During our tests we found that machines equipped with RAID hardware arrays were no faster than those equipped with multiple SLEDs configured as drive arrays with data striping un-

The closer you look at the Z-Server's performance, the better the system appears. On our crucial random read/write tests over a variety of file and packet sizes, the Z-Server's performance was always solid. But when we increased the number of clients, the Z-Server pulled ahead of the pack in most of the tests (for a more detailed explanation of the tests, see What the Numbers Mean). In other words, when other file servers hit the performance barrier and bogged down, the Z-Server shined.

Even at peak throughput, the ZDS server was never using more than 80 percent of its processing power, allowing the system to perform double duty as a print server when needed. Partially the result of relying on a 486DX/50 CPU, rather than a 33-MHz or clock-doubled 66-MHz processor, the Z-Server can efficiently move more data over a variety of real-world conditions than any of the other file servers we tested.

In a move that points to a PC industry dominated by strategic alliances between makers of systems and components, the Z-Server—along with the DECpc 450ST—relies on Intel to engineer its motherboards. Far from a criticism, this is rather an indication that these system manufacturers are content to work with the world's top technology sources. Having outside companies contribute their own specialty products allows the system maker to concentrate on integrating the many complicated parts into a unified whole.

der NetWare. The more effective drive array setups demand a well-balanced disk configuration. Pairing a very large drive and a very small drive together reduces the effectiveness of striping by forcing most of the data to be written to the larger drive. This was the case with the DECpc, which mated a 1GB hard disk with a 245MB hard disk—and paid a performance penalty.

If disk I/O is the religion of servers, then the disk controller must be its god. There are dozens of different controllers on the market today, but, broadly speaking, they break down into two groups: caching and noncaching. In the case of a PC, caching controllers often can give you an advantage by caching reads and writes to disk.

However, network operating systems like NetWare are plenty effective at caching requests. There may also be conflicts between the hardware and software caches that end up slowing the whole process down, so paying for this extra cache may actually *hurt* disk performance.

Indeed, during our tests we suspected that disk-caching controllers could in fact be detrimental to performance. For example, the machine from AST came with a disk-caching controller and did poorly on some tests. We also encountered some strange behavior when testing the Dell under peak loads. Starting at a client load of 40, it would let clients time out, causing a network error to occur.

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NETWORK ADAPTERS

Next to increasing the number of spindles, adding multiple adapters is the best way to reduce the network bottleneck on a file server.

With high-speed I/O buses such as EISA, multiple network adapters provide more gateways for transferring data, allowing greater throughput. You do need to be careful, however, with the number of adapters installed. Each Madge adapter that we added to the machine took at most 22 percent of the processor's bandwidth.

In some instances, using different adapters affected a server's performance. Compaq insisted, for example, that the ProSignia be configured with its NetFlex adapters, which can run both Ethernet and Token-Ring protocols. We found that the NetFlex card actually offered good performance.

By contrast, HP shipped its machine with Olicom network cards, but because of an incompatibility in the drivers or in the cards provided, CPU utilization jumped to 100 percent with just one station attached to the network. We tested the machine with the Madge cards instead, and found the server to be a midrange performer.

Finally, though you can't judge a vendor based on a single incident, we were distressed to find that AST shipped us bad Madge adapters. The cards appeared to us to be beta adapters. We simply replaced their adapters with our own Madge cards.

SOUPED-UP CPU

Common wisdom has it that the network adapter and the disk—not the CPU—are what really matter in a file server. Since the file server, as this truism goes, provides access to network files, it stresses the processor-disk interface and the processor-network I/O interface, not the processor-memory interface.

Surprisingly, we found that this is simply not true. In some very important cases, faster processors can make a noticeable difference in performance. Because of the way NetWare reads data from the hard disk, the most dramatic performance improvements occur when there are large disk caches in RAM.

With a large number of disk requests able to be cached into server memory, repeat reads of cached data exercises the CPU/memory subsystem. Additional tests performed by PC Labs demonstrated up to a 30 percent performance improvement from a DX/33 to a DX2/66 configuration when servicing many small data requests from workstations. On average, the DX2/66 improved performance by around 5 to 10 percent over the DX/33 with all other configuation elements being equal.

Consequently, you'll also want to use a large amount of server memory for caching. The amount you'll want to use will vary, but we found 32MB to be plenty for our test network. This way, if many users

RAID Technology: *How Safe and How Inexpensive?*

RAID (Redundant Array of Inexpensive Disks) replaces large, expensive storage systems with multiple, smaller, identical PC-style hard disk drives. Potentially, RAID technology can cut storage costs, increase speed, and improve overall system reliability.

What can RAID technology really deliver for you? It depends on your system goals.

The RAID array responds only as a large single drive, rather than as several drives identified by letters (in the case of multiple hard disks linked to a standard PC). More importantly, the contents of a single file are not concentrated on a single hard disk, but are spread across all the drives in the array, increasing the safety of the data.

This safety comes at a cost, however. Price per megabyte decreases as hard disk capacity increases, so several small hard disks inherently cost more than one larger unit of the same total storage space.

For example, the list price of a 210MB Maxtor MX7213S drive is about $419 ($2 per megabyte) while the same company's 1.5GB P1-17S carries a list price of $2,415 ($1.61 per megabyte).

RAID also requires a special—and expensive—hard disk controller, such as the EISA-based Ultrastor Ultra 124F, which carries a list price of $1,995. In this case, the whole is not the sum of its parts. A RAID system will deliver less total storage than its constituent drives.

The redundancy in the RAID design means that a portion of the stored data is duplicated to help detect or correct disk errors. This method of system storage puts an end to read and write errors and provides true fault tolerance. Furthermore, RAID systems can provide network users with full access to all data, even when a single hard disk in the array catastrophically fails.

This technology goes beyond reliability issues to improve performance. The multiple RAID drives can read and write data in parallel—splitting information between drives at the bit, byte, or block level using a process called data striping—and can potentially multiply peak data-transfer rates by the number of drives in the array.

Advanced hard disk controllers can handle multiple seeks simultaneously, a searching method that cuts down access time to almost zero. With this process, one of the drives seeks while the system reads from other drives.

RAID systems can provide users with full access to all data even when a single hard drive in the array fails catastrophically.

FIVE LEVELS OF RAID

RAID comes in five different flavors—levels one through five—each one designed for a specific use. These numbers are simple designations for the different methods used for protecting hard disk data and do not describe levels of speed or of quality: RAID 1 is neither better nor worse than RAID 5. The correct type of RAID for your particular server depends on how you use your network.

RAID 1 means total redundancy—two equal-capacity disks that duplicate the contents of (or mirror) one another. One automatically and continuously backs up the other. The array reverts to ordinary single-drive operation if either unit fails.

The RAID 1 system is designed for essential data that would be expensive or difficult to replace. While this duplication cuts potential hard disk storage capacity in half, it typically does not affect performance.

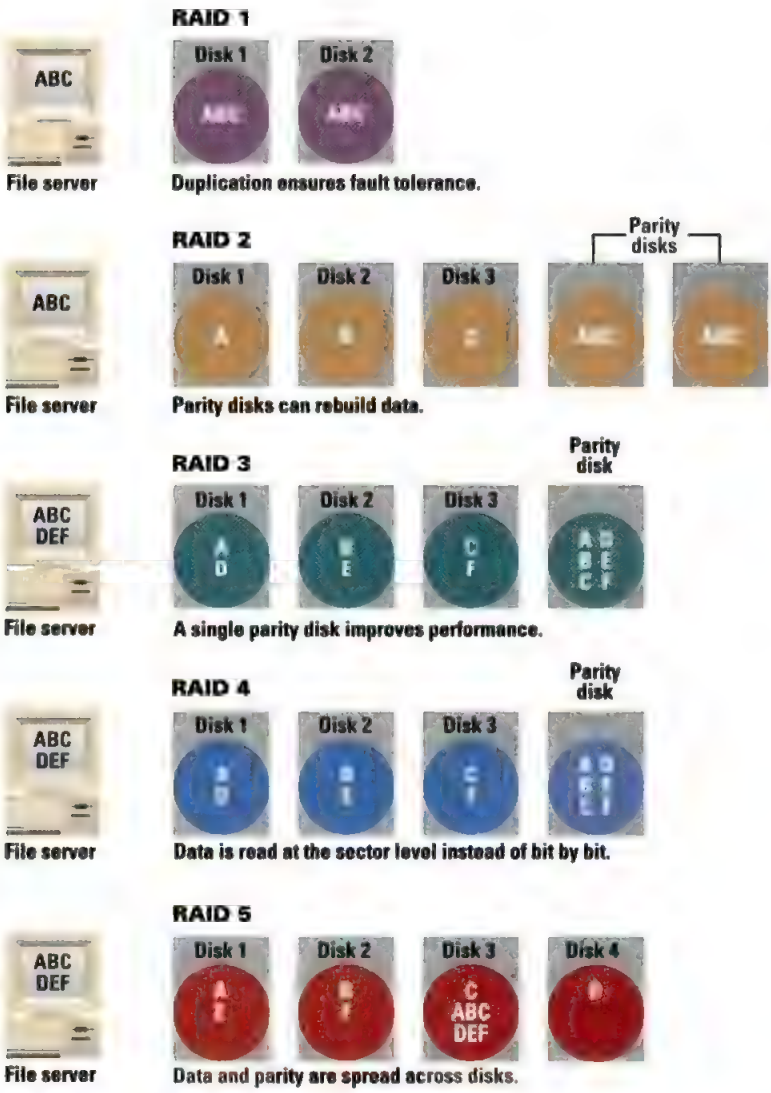
However, sophisticated RAID 1 controllers can potentially double data throughput by simultaneously reading alternate sectors from both drives.

RAID 2 splits each bit of data bytes or blocks among separate drives and then adds in several more drives for error correction. For example, a RAID 2 system would store a 16-bit digital portion across 16 drives with 5 or 6 additional drives intended for error-correction, or parity, information. The exact number of error-correction drives used by your system depends on the specific allocation algorithm used.

The disk-size penalty can be as high as 37.5 percent; three correction bits per eight data bits. In addition, the RAID 2 design increases the size of the minimal storage unit (sector size is multiplied by the number of drives, a 16-drive array has 8,192-byte sectors), making it inefficient for storing smaller files across so many drives. On the other hand, RAID 2 achieves high transfer rates because the drives deliver their bits in parallel.

Errors are corrected on the fly without a performance penalty because the controller can reconstitute most errors from the redundant information without rereading the drives.

RAID 3 dispenses with some of the thoroughness of RAID 2 by utilizing error detection rather than error correction. Error detection through the process of parity checking requires fewer extra drives in the array—typically only



This graphic illustrates how blocks of data would be spread across the hard disks in a server under the different variations of RAID (Redundant Array of Inexpensive Disks) technology. The letters A, B, C, D, E, and F represent sectors or bits of data, depending on the type of RAID.

one per array. When an error is detected by the controller, it makes the array reread the data to resolve the problem. This requires an extra spin of all the drives in the array, typically adding a small delay to the disk operation.

RAID 4 systems work at the sector level rather than at the bit level. Files are split between drives by sectors, the sectors are read serially—the first from one drive, the second from the next drive, and so on.

For error detection, RAID 4 adds a dedicated parity drive, while a RAID 4 controller can improve performance with data striping. Two or more sectors from different drives can be read simultaneously, stored in fast RAM, and sequentially delivered at RAM rates.

The better RAID 4 controllers also process multiple data requests simultaneously, reorganize them, and then read their drives in the most efficient manner, a technology known as elevator seeking. Writing is slower than reading, however, because RAID 4 uses read-after-write technology. After data is written to the disk, it is read to determine parity, and then the parity data is written to the parity drive.

RAID 5 eliminates the dedicated parity drive from a RAID 4 system. The parity-check information is added as another sector that rotates through the array's drives exactly like ordinary data. For added performance, RAID 5 controllers can add data striping and elevator seeking. In addition, enough redundancy can be built in to make the system fault tolerant.

PROS AND CONS OF RAID

Two RAID types dominate the arrays used by PCs. RAID 1 is popular in Novell NetWare servers, although Novell usually refers to this technology as mirroring. Most of the PC-based devices called drive arrays, however, fit the RAID 5 design, since RAID 4 offers no real advantages, and RAID 2 and 3 require too many drives and hold too many other disadvantages to be useful for most PC applications.

Besides the extreme capacities possible with multiple drives, the only advantage RAID offers single-user PCs is a higher potential data-transfer rate. DOS uses serial input and output (one storage request must be fulfilled before another is issued), which does not benefit from elevator seeking. Moreover, the extra reliability of a RAID system is a dubious virtue when ordinary hard disks boast MTBF (mean time between failure) ratings of between 150,000 to 350,000 hours.

PC-based servers and RAID technology shine best when compared to traditional mainframe and minicomputer mass storage systems: disk drives the size of small refrigerators that can cost upwards of $100,000. The redundancy of RAID substitutes for the mechanical robustness of the big drives, while achieving identical or even better reliability. Mass-market pricing makes arrays of small PC-size drives relatively affordable.—*Winn L. Rosch*

are accessing files in your network, the requests will be cached. Since the cache resides in DRAM, you'll want a server with fast DRAM. The minimum performance that you should accept is between 8,000 and 10,000 memory operations per second on a 486DX2/66 as tested with PC Bench 7.0. Note that these numbers are for single-processor servers, not multiple processors.

FINISHING TOUCHES

Once you leave the performance realm, these servers really differentiate themselves in their designs. Insuring the quality of hardware design and reliability is difficult. One simple way to tell if the hardware is well-thought-out is to remove the unit's cover and then put it back on. Look for covers that are easy to remove and quickly replaced, as was the case with the ZDS and Acer systems.

One helpful feature on the Dell PowerLine system is a guide for directing cables around the back of the computer.

Beyond opening and closing the server, these products differed in both their external and internal designs. Externally there were few important differences. Dell was the only vendor to supply wheels with their product, which we found very helpful when moving the server.

Dell had a nice feature: a cable guide for directing cables around the back of the computer. This conduit helps organize the morass of cabling that can crop up around a server, making problems easier to troubleshoot. Another nice touch is an LCD screen for system messages. The problem is that most external LCD panels tend to show merely the system's clock speed or whether it passed the initial self-test—not what you'd call essential information.

Internally, many of these products were vastly different. Plenty of space and easy-to-remove drives are very important when troubleshooting a server.

Though its tested configuration was the most expensive in this review, the AST system was the most effectively laid-out server we saw. If you want to remove a drive, for example, just twist on either side of the drive and pull it out. The Z-Server had a similar setup, but its drives required a bit more effort to remove.

With all of these products, security was at a minimum. Password and keyboard security were provided, but we found the provided locks to be completely useless. A large screwdriver was all that was needed to gain access. Clearly these units are meant to be stored either in a separate room or among employees who won't tamper with the hardware.

OLD RELIABLE

During our testing we were faced with perhaps the most convincing argument for paying careful attention to the vendor's service and support network. Having finished testing the AcerFrame 1000/50, we accidentally chipped off a resistor from the drive controller.

With the drive array configuration stored in flash memory on the controller, using a new controller would have meant having to reconfigure our drive array. Instead of shipping us a new controller, Acer came on site, soldered the resistor back onto the controller, and got the server up and running.

Acer includes 90 days of free on-site service—more than enough time to break a machine in. Other vendors in this test group offered anywhere from no on-site support at all to one free year of on-site support to a $9.95 yearly fee. Service information, along with a multitude of other details, can be found in the "Summary of Features" table, and should be cross-referenced with the vendors' service-and-reliability results, which are included in the product reviews.

There were a few other incidents that gave us some problems, such as the fact that AST had to provide us with three processor boards before the company could get one to work.

Finally, the power supplies driving these systems should be rated at about 300 watts, a level reached by all tested machines except for the Compaq and DEC systems. But don't always trust the warning signs that some servers will generate when you exceed the maximum wattage. Take the ZDS Z-Server 450DE, for example.

When we inserted a fourth Madge Token-Ring adapter into the Z-Server, the machine sent an error message complaining that we had exceeded its maximum power-consumption rating. The vendor's representative instructed us to continue with the test and to ignore the message. We did, and the product continued to operate flawlessly.

In a market that lives and dies by the bottom line, the main factors that differentiate these products are price, performance, and design. And although all of these file servers may force you to trade-off some features and functions, the systems we tested are perfectly suited for medium-sized workgroups.

Acer America Corp.

AcerFrame 1000/50

BY BRUCE BROWN

You can upgrade Acer America's AcerFrame 1000/50 server with a second CPU or even replace the CPU with a Pentium processor when it becomes available.

At $12,834, the test configuration includes a 486DX/50 CPU, 32MB of RAM, a 256K external RAM cache, 2GB of hard disk space, and four network interface cards. System memory capacity is limited to 64MB on the motherboard, although an expansion card can accommodate another 56MB of system memory for a total of 120MB. Mid-level results on the network-throughput benchmark tests peg the Acer machine as a reliable but not extraordinary file server.

The AcerFrame 1000/50

The system's moth-

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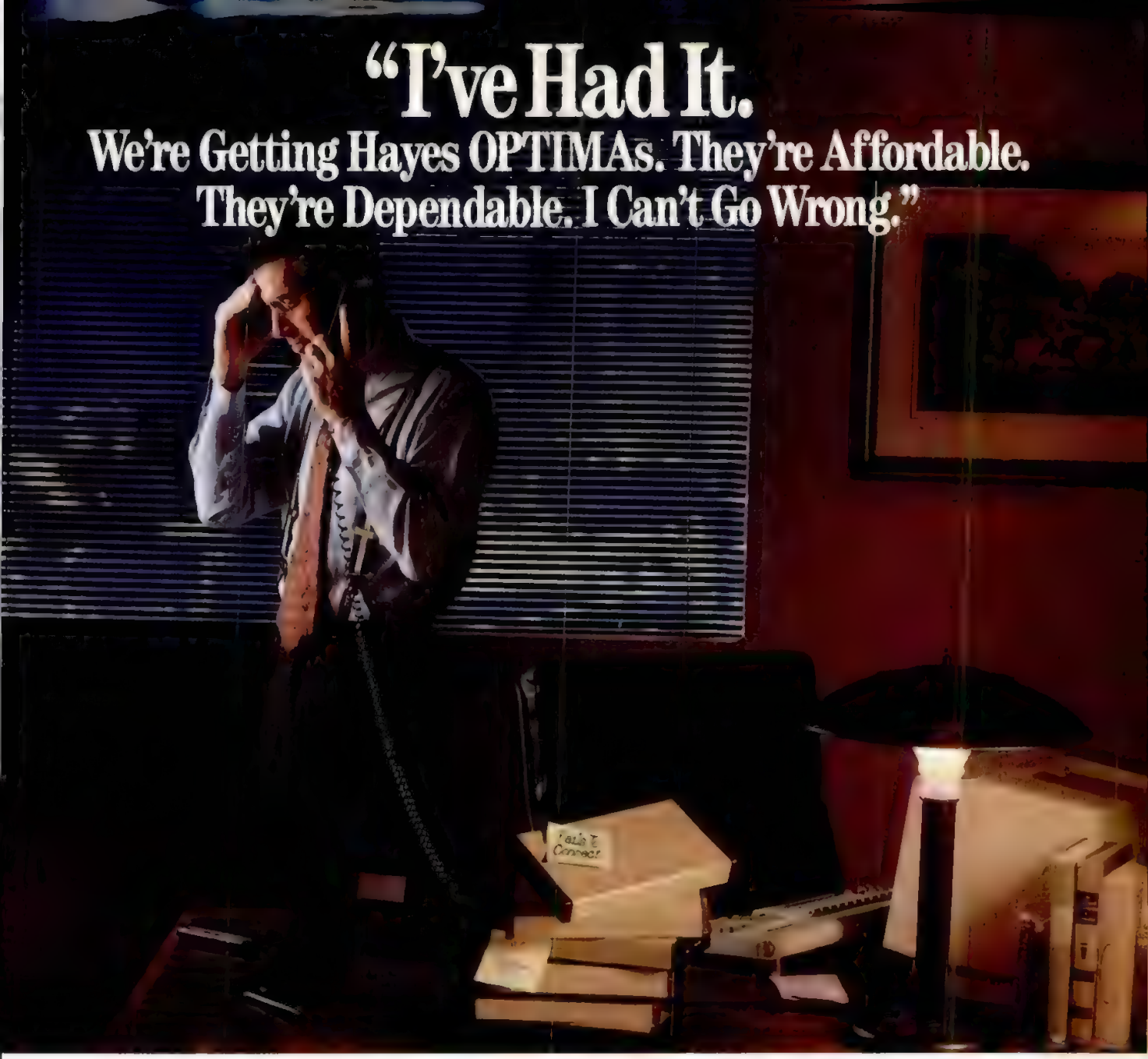

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CIRCLE 136 ON READER SERVICE CARD

Glossary

application server A type of file server optimized for specific tasks, such as acting as the engine for a large database. It generally uses higher-end hardware than typical file servers. A **super server** is a high-performance system usually characterized by advanced multiprocessing features, scalable I/O channels, and a hefty price tag.

bus mastering A technique that allows advanced bus architectures to delegate control of data transfers between the CPU and associated peripherals, allowing network cards greater system bus access and better transfer speeds.

drive array A combination of several hard disks and a special controller, which allows for faster data access with special security and LAN management functions (see *RAID*).

network adapter or **network interface card (NIC)** Cards that effectively function as the backbone of the LAN. Network interface cards come in two varieties. One type is installed at each node on the network, while the other type is installed at the network server. In combination with software drivers, these cards allow nodes to communicate on the LAN.

RAID Redundant Array of Inexpensive Disks; a drive array of low-cost (often IDE) hard disks used by file servers to store LAN and end-user data files. A RAID has one of five data-security levels, plus fault tolerance and other LAN-management features.

SCSI Small computer system interface; a high-speed data exchange interface that can distinguish among up to seven devices on a single connection. Today SCSI is most often used with hard disks, tape drives, and other mass storage media. The interface's only hurdle to mass acceptance has been the lack of a usable standard manufacturers' specification.

SLED A single large expensive disk. Until quite recently, such hard disks were unable to support any RAID features. Some new high-end disk controllers are now allowing one or two large disks to support certain RAID functions; the two most common functions supported are disk mirroring and limited fault tolerance.

Compaq Computer Corp.

Compaq ProSignia 486DX2/66

BY OLIVER RIST

Compaq calls its $12,627 ProSignia 486DX2/66 a "low-cost" server, but the unit didn't really distinguish itself from other servers costing much less. In fact, the ProSignia's only unusual feature is its Insight LAN-management capabilities.

Even a cursory examination shows evidence of the Prosignia's "low-cost" direction. The case is poorly finished both inside and out, with rough support struts that can be a hazard when you work inside the case. The power supply is only 240 watts, and there are no front-panel or case locks.

The Compaq ProSignia 486DX2/66

Inside, you'll see a little more effort, but you still have to weigh what Compaq gives you against what it doesn't. The basics are all there, including a 256K external processor cache. But you can expand RAM to only 128MB, as opposed to 256MB for some competitors.

Compaq claims that you can upgrade easily via an Intel OverDrive chip. The ProSignia has a LIF (Low Insertion Force) socket; in contrast, most of the other tested servers put their CPUs on easily replaceable plug-in cards. Also, with a DX2/66 installed, the next upgrade would be to a Pentium, and it isn't clear right now whether the ProSignia will support such a processor.

Compaq ProSignia 486DX2/66

SUITABILITY TO TASK	
Scalability	FAIR
Security/fault tolerance	EXCELLENT
NIC throughput	EXCELLENT
CPU utilization	EXCELLENT

The ProSignia has 8 drive bays (versus the 11 commonly found on other units) and 7 EISA bus mastering slots (versus 8 or more in many other systems). Compaq touts a Flexible Advanced System Architecture that you may mistake for the highly respected 128-bit Tri-Flex design found in the ultra high-performance SystemPro products. But don't be fooled—the ProSignia uses a 32-bit memory bus that produced standard EISA performance.

Compaq did, however, supply a number of hardware features curiously missing in most of the competition, such as an internal Fast SCSI-2 connector that ran four 550MB SCSI hard disks for a 2.2GB capacity. This arrangement has no RAID support, though that's available on other drive array models that Compaq did not include in this review.

The Insight software, too, has server-management features that are missing in many of its competitors, including re-

FACT FILE

Compaq ProSignia 486DX2/66

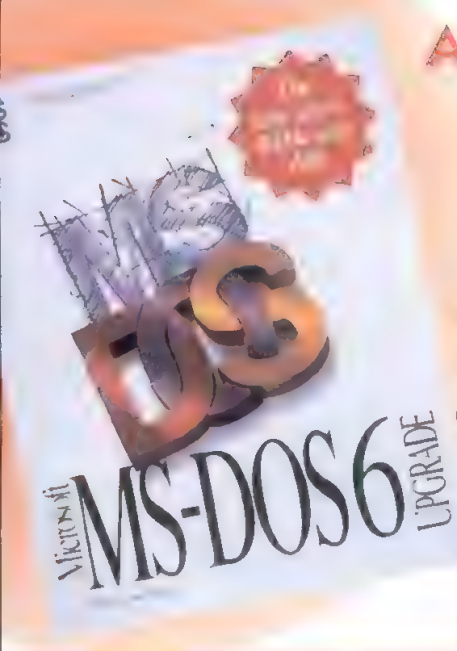
Compaq Computer Corp.,
P.O. BOX 692000,
Houston, TX 77069-2000;
800-345-1518, 713-370-0670

List price (tested configuration): $12,627.

Configuration: One Intel 486DX2/66 processor, 32MB RAM with 256K write-back cache, four Hewlett-Packard or Fujitsu 550MB Fast SCSI-2 hard disks, one Compaq Fast SCSI-2 hard disk controller (no cache), one 1.44MB floppy disk drive.

In short: Compaq's definition of a "low-cost" server turned this unit into a badly finished and somewhat stripped-down competitor. Only its bright performance scores, some nice hardware features not found on other tested units, and the ability to add a bunch of higher-end options save it.

ON READER SERVICE CARD



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CIRCLE 225 ON READER SERVICE CARD

Upgrading Your LAN

Tips on Making Better Connections

Adding a few new employees or even a whole new department? The old Ethernet highway getting a little congested? You can stretch your storage capacity and your data bandwidth, and rev up your throughput without splotching large red marks all over your budget.

Don't jump the gun and automatically buy a higher-end server: If your network needs a quick throughput boost, there are some cheaper and more effective upgrade solutions available to you.

PC Magazine Labs conducted a series of anecdotal tests aimed at discovering which network configurations provided optimal performance under typical 16- and 32-workstation LAN (local area network) configurations. We altered server hardware, processor platforms, memory configurations and the number of connected workstations.

Even though actual workstations numbered only between 16 and 32 nodes, our client stations running NetBench heaped far more stress on the server's disk and memory subsystems than normal.

This is because our tests assumed that all of the nodes are accessing the server at the same time. On the average network, only a fraction of the nodes are active at any given time.

Throughput levels similar to what we reached on our tests would generally be encountered on LANs with 100 users or more.

The bottom line? Fundamentally, for a quick-and-easy network speed boost you have three options:

- Upgrade your server's processor,
- Add system memory, or,
- Add more segments to your LAN.

Of these three upgrading options, adding more server RAM is by far the most inexpensive method, although it still offers a dramatic gain in throughput as well.

BREAKING DOWN YOUR OPTIONS

Adding one or more new segments to your network is the most expensive solution, although it will almost always bring substantially faster throughput. Segmenting your LAN basically means dividing a big LAN into a bunch of smaller ones.

The process involves taking a number of workstations off of a crowded connection and giving them their own connection, either to a new network interface card (NIC) in the primary server or to a router or bridge, or even giving them their own server.

Of the variables that we tested, server RAM made the most noticeable impact on the performance of the server.

In short, you're adding another lane on your data highway. The higher the ratio of lanes to traffic, the faster your traffic flows.

A faster processor showed only modest performance gains on our tests: on average a six to seven percent increase between a 486DX/33 and a 486DX2/66 with large data packets (on our 1K, 2K, and 4K random read/write tests).

However, speedier silicon does give noticeably faster throughput when processing small, mostly cached packets. Again comparing a 486DX2/66 processor to a 486DX/33, we found an average processing increase of about 27 percent using 64-byte and 128-byte packets.

The main processor is less important when large data blocks are transmitted because more emphasis is being placed on the network interface cards and their drivers. PC Magazine Labs used high-speed Madge cards to obtain its results.

Of the variables tested, server RAM made the most noticeable impact on server performance. On PC Labs' test network, performance increased by over 50 percent when we increased the server's RAM from 16MB to 32MB.

The secret is NetWare's cache. With each of the 16 PC Labs test workstations clamoring for a 1MB test file, the 32MB server configuration was able to hold the entire load in its memory cache. The 16MB version, however, often had to make relatively tedious disk accesses.

If your network load has increased, adding a few more SIMM modules is a much cheaper and simpler solution than either replacing the processor or adding new segments.

This is not to say that you should just keep cramming RAM into your servers and expect system throughput to improve with each addition of a new chip or module.

Every performance curve eventually peaks and you'll reach a point where installing extra RAM becomes a waste of time and money. You'll be far better off by taking a long-term view of network management.

If you know that your network's increased load today is only an early indication of even more activity later, the most efficient solution may be to purchase a new server, bridge, or router now and leave the memory push for a later date. It pays to think ahead.

—*Oliver Rist*

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CIRCLE 308 ON READER SERVICE CARD

RAID Technology: *How Safe and How Inexpensive?*

RAID (Redundant Array of Inexpensive Disks) replaces large, expensive storage systems with multiple, smaller, identical PC-style hard disk drives. Potentially, RAID technology can cut storage costs, increase speed, and improve overall system reliability.

What can RAID technology really deliver for you? It depends on your system goals.

The RAID array responds only as a large single drive, rather than as several drives identified by letters (in the case of multiple hard disks linked to a standard PC). More importantly, the contents of a single file are not concentrated on a single hard disk, but are spread across all the drives in the array, increasing the safety of the data.

This safety comes at a cost, however. Price per megabyte decreases as hard disk capacity increases, so several small hard disks inherently cost more than one larger unit of the same total storage space.

For example, the list price of a 210MB Maxtor MX7213S drive is about $419 ($2 per megabyte) while the same company's 1.5GB P1-17S carries a list price of $2,415 ($1.61 per megabyte).

RAID also requires a special—and expensive—hard disk controller, such as the EISA-based Ultrastor Ultra 124F, which carries a list price of $1,995. In this case, the whole is not the sum of its parts. A RAID system will deliver less total storage than its constituent drives.

The redundancy in the RAID design means that a portion of the stored data is duplicated to help detect or correct disk errors. This method of system storage puts an end to read and write errors and provides true fault tolerance. Furthermore, RAID systems can provide network users with full access to all data, even when a single hard disk in the array catastrophically fails.

This technology goes beyond reliability issues to improve performance. The multiple RAID drives can read and write data in parallel—splitting information between drives at the bit, byte, or block level using a process called data striping—and can potentially multiply peak data-transfer rates by the number of drives in the array.

Advanced hard disk controllers can handle multiple seeks simultaneously, a searching method that cuts down access time to almost zero. With this process, one of the drives seeks while the system reads from other drives.

RAID systems can provide users with full access to all data even when a single hard drive in the array fails catastrophically.

FIVE LEVELS OF RAID

RAID comes in five different flavors—levels one through five—each one designed for a specific use. These numbers are simple designations for the different methods used for protecting hard disk data and do not describe levels of speed or of quality: RAID 1 is neither better nor worse than RAID 5. The correct type of RAID for your particular server depends on how you use your network.

RAID 1 means total redundancy—two equal-capacity disks that duplicate the contents of (or mirror) one another. One automatically and continuously backs up the other. The array reverts to ordinary single-drive operation if either unit fails.

The RAID 1 system is designed for essential data that would be expensive or difficult to replace. While this duplication cuts potential hard disk storage capacity in half, it typically does not affect performance.

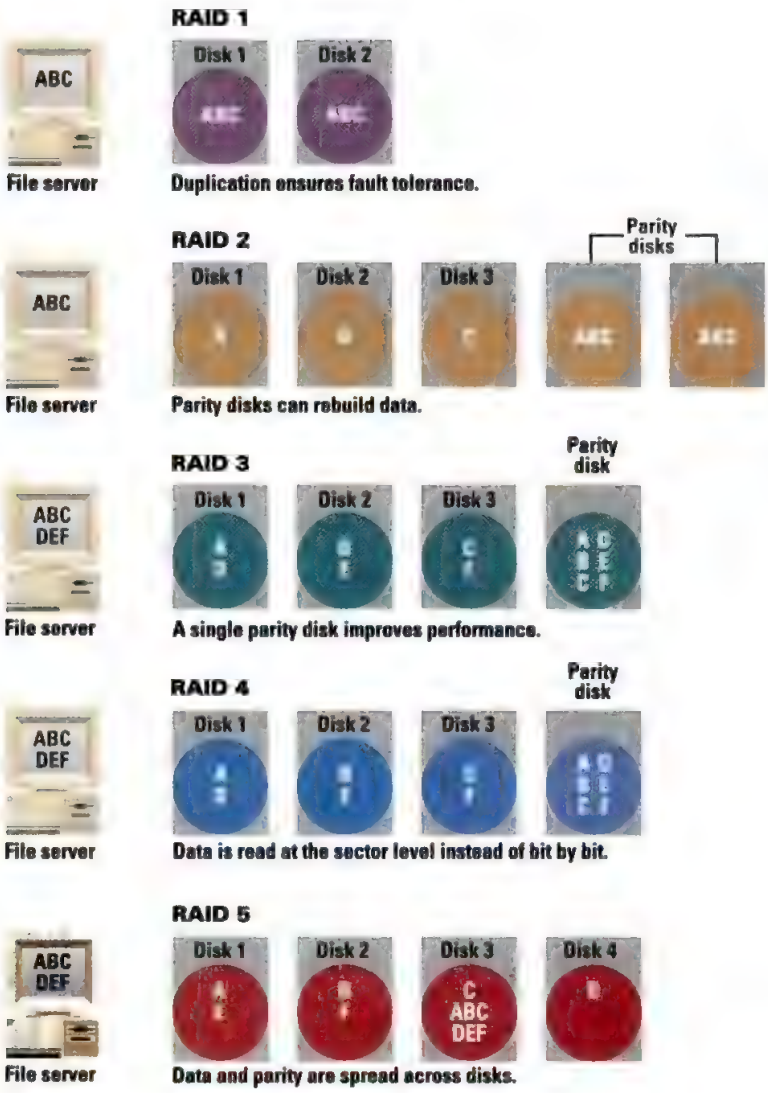
However, sophisticated RAID 1 controllers can potentially double data throughput by simultaneously reading alternate sectors from both drives.

RAID 2 splits each bit of data bytes or blocks among separate drives and then adds in several more drives for error correction. For example, a RAID 2 system would store a 16-bit digital portion across 16 drives with 5 or 6 additional drives intended for error-correction, or parity, information. The exact number of error-correction drives used by your system depends on the specific allocation algorithm used.

The disk-size penalty can be as high as 37.5 percent; three correction bits per eight data bits. In addition, the RAID 2 design increases the size of the minimal storage unit (sector size is multiplied by the number of drives, a 16-drive array has 8,192-byte sectors), making it inefficient for storing smaller files across so many drives. On the other hand, RAID 2 achieves high transfer rates because the drives deliver their bits in parallel.

Errors are corrected on the fly without a performance penalty because the controller can reconstitute most errors from the redundant information without rereading the drives.

RAID 3 dispenses with some of the thoroughness of RAID 2 by utilizing error detection rather than error correction. Error detection through the process of parity checking requires fewer extra drives in the array—typically only



This graphic illustrates how blocks of data would be spread across the hard disks in a server under the different variations of RAID (Redundant Array of Inexpensive Disks) technology. The letters A, B, C, D, E, and F represent sectors or bits of data, depending on the type of RAID.

one per array. When an error is detected by the controller, it makes the array reread the data to resolve the problem. This requires an extra spin of all the drives in the array, typically adding a small delay to the disk operation.

RAID 4 systems work at the sector level rather than at the bit level. Files are split between drives by sectors, the sectors are read serially—the first from one drive, the second from the next drive, and so on.

For error detection, RAID 4 adds a dedicated parity drive, while a RAID 4 controller can improve performance with data striping. Two or more sectors from different drives can be read simultaneously, stored in fast RAM, and sequentially delivered at RAM rates.

The better RAID 4 controllers also process multiple data requests simultaneously, reorganize them, and then read their drives in the most efficient manner, a technology known as elevator seeking. Writing is slower than reading, however, because RAID 4 uses read-after-write technology. After data is written to the disk, it is read to determine parity, and then the parity data is written to the parity drive.

RAID 5 eliminates the dedicated parity drive from a RAID 4 system. The parity-check information is added as another sector that rotates through the array's drives exactly like ordinary data. For added performance, RAID 5 controllers can add data striping and elevator seeking. In addition, enough redundancy can be built in to make the system fault tolerant.

PROS AND CONS OF RAID

Two RAID types dominate the arrays used by PCs. RAID 1 is popular in Novell NetWare servers, although Novell usually refers to this technology as mirroring. Most of the PC-based devices called drive arrays, however, fit the RAID 5 design, since RAID 4 offers no real advantages, and RAID 2 and 3 require too many drives and hold too many other disadvantages to be useful for most PC applications.

Besides the extreme capacities possible with multiple drives, the only advantage RAID offers single-user PCs is a higher potential data-transfer rate. DOS uses serial input and output (one storage request must be fulfilled before another is issued), which does not benefit from elevator seeking. Moreover, the extra reliability of a RAID system is a dubious virtue when ordinary hard disks boast MTBF (mean time between failure) ratings of between 150,000 to 350,000 hours.

PC-based servers and RAID technology shine best when compared to traditional mainframe and minicomputer mass storage systems: disk drives the size of small refrigerators that can cost upwards of $100,000. The redundancy of RAID substitutes for the mechanical robustness of the big drives, while achieving identical or even better reliability. Mass-market pricing makes arrays of small PC-size drives relatively affordable.—*Winn L. Rosch*

What the Numbers Mean

What did we find out from subjecting our nine test servers to one of ZD Labs' NetBench tests? First, we discovered that systems with 486DX/50 processors should have a performance advantage over 486DX2/66 systems in reading data from disk cache memory. An inferior disk subsystem or network adapter, however, can easily offset the gains.

The DECpc 450ST, which included two different-size hard disks, or *spindles*, exemplified the type of system that matches a powerful processor with a weak disk setup. Basing a striped server system (a system on which data is split up or "striped" across multiple drives) on two spindles can result in slow sequential access compared with striped systems that have three or more spindles.

If the same amount of data is being accessed randomly from two- and four-spindle striped systems of similar capacity, for example, the heads in the two-spindle system will have to move further out on the disk surface than on the four-spindle system, causing longer wait times.

File-server performance depends more on the disk or network adapter installed than on the CPU. Bus-mastering network and disk adapters further reduce the workload placed on the CPU; all of the tested servers used such adapters.

The **Random Read/Write** test measures the raw speed of random disk access. The servers exhibited high disk-cache hit rates on this test until we loaded them with a certain number of users. The number varied by machine. After each server reached its threshold, the disk subsystem became the main performance bottleneck. This performance "knee," the spot where the throughput curve turns downward, is the most important element to look for in this test. Systems that can maintain high throughput levels and extend the knee the farthest along the *x*-axis are often the best overall performers.

Another significant issue is CPU utilization, a measure of how hard the processor worked during testing. File size is also an important factor, as seen in the performance curves. Throughput is substantially increased with larger read/write request block sizes. The Dell 466SE/DSA PowerLine Server delivered the best throughput across all versions of the random read/write test, but its excellent results are attributable to its four-spindle, 4GB disk subsystem. The disk heads on such a subsystem do not have to move as far out on the disk surface as they do on the 2GB subsystems used in most of the other servers.

The Compaq ProSignia 486DX2/66 delivers a good balance of throughput and CPU utilization. But the ALR ProVEISA VM 4/66d, with its two 1.2GB Maxtor drives, takes a nosedive in throughput, becoming totally disk-bound (very low CPU utilization) with 512K files in various block sizes on a network of 60 users.

The ZDS Z-Server 450DE's throughput peaked at 20 users on the 512-byte block portions of the test. This performance is probably attributable to its DX/50 CPU, because most reads are performed from disk cache.

We also ran the Random Read/Write test separately with 2MB, 4MB, and 8MB files on a network of 120 users. The results show significantly reduced throughput; the random-access speeds of the server disk subsystems are reflected on the test score graphs.

With more than 60 clients running 512K files, and with between 20 and 40 users running 1MB files, most systems hit a "disk wall." At this performance barrier, requests are no longer mostly serviced from disk cache. With more than 32MB of system memory, you would probably experience better peak performance for a large number of users.

How We Tested

THE SETUP

The ZD Labs networking team in Foster City, California, conducted file-server benchmark testing under the supervision of networking specialist David Frerichs. ZD Labs has a large, flexible network that can accommodate more than 200 active workstations. For the midlevel class of server under examination, we chose to use 120 stations as our maximum load.

We installed Novell's NetWare 3.11 on all servers and requested that vendors include 32MB of RAM and anywhere from 1.2GB to 2.0GB of disk storage. Dell did not market a disk subsystem with less than 4GB, so we used its 4GB drive array (four 1GB drives). We configured this array so that it appeared to NetWare as a 2GB volume for testing, but with double the disk capacity of the other tested systems, the Dell system still had an advantage over a true 2GB subsystem.

Even the large-file runs of our disk test, which force the largest radial displacement of the heads, move the drive heads on the Dell system no more than one-quarter of the maximum distance in its 4GB drive array. The Dell system performed unusually well, partly as a result of this configuration.

NetWare 3.11 was installed with 4K disk block sizes and a maximum physical receive-packet size of 4,202 bytes. NetWare disk-cache RAM size defaulted to approximately 28MB in all servers. MAC-level (media-access control–level) packet sizes were left at default values on all network adapters; each was capable of supporting up to 4Kof data per 802.5K frame. We did not use burst-mode IPX.

All tested systems included at least two hard disks, but only three—the units from Acer, AST, and Dell—were configured with true hardware RAID (Redundant Array of Inexpensive Disks) drive subsystems (for more information on RAID, see "RAID Technology: How Safe and How Inexpensive?" on page 194). We set up all hardware RAID subsystems for RAID level 0, which has striping without parity and is the fastest RAID configuration. We set up the rest of our tested units with their multiple SLED (single large expensive disk) drives as one large logical NetWare partition using NetWare's own striping feature.

THE TESTS

Our goal was to stress the servers' ability to dole out data to clients, so we measured the **I/O throughput** by running the Random Read/Write test from ZD Labs' NetBench, Version 2.05. We measured the **average CPU utilization** level during each run of the test, using NetWare's STAT.NLM utility. Our measurements let us determine how much CPU bandwidth might be left for other processing tasks if the server were to perform extra duty as a print, communications, or database server. STAT.NLM uses a minimal amount of CPU resources and functions as a fixed overhead in all tested servers.

NetBench delivers application-level read and write requests through the NetWare client software, where the requests are interpreted and transported through the physical network to the server. During each run of the test, multiple workstations constantly fire requests at the server's disk subsystem, which includes not only the physical disk hardware but also the large NetWare RAM-based disk cache. The NetBench test runs for 10 minutes, to minimize startup overhead and to ensure stable and repeatable results.

We decided to run the test with 8-, 20-, 40-, 60-, 80-, 100-, and 120-client networks. During the test, the workstations continuously pound the server; a test with 20 NetBench nodes concurrently accessing the file server is usually equivalent to a much larger network of actual installed workstations. For example, your network might have 200 installed nodes but only 20 actively requesting file services at any one time.

Our test results are most meaningful for comparing relative server performance, but the scores will guide you in determining some of the other strengths and weaknesses of these servers. You will note that as the number of active clients approaches 120, the performance differentials become increasingly significant.

NetBench 2.05 can use read/write blocks as small as 512 bytes in the Random Read/Write test, whereas Version 2.0 could go only as low as 1K. We determined that 512-byte blocks correlate to the sector-size increments in which many applications request data. Popular network-based database applications request data from the server in 512-byte chunks. To produce realistic results yet keep testing manageable, we chose both 512-byte and 4K block sizes as our testing standards.

After choosing the read/write block sizes, we decided that each workstation should be tested with files of either 512K or 1MB. These file sizes are commonly used in database, spreadsheet, and word processing applications. We also ran worst-case tests at the 120-user level that utilized 2MB, 4MB, and 8MB files, to maximize the movement of the disk heads. If, for example, each of the 120 workstations were to access its own 8MB file at the same time, they would effectively cover at least 960MB of disk space. We purposely used test files whose contents were not defragmented (laid out contiguously on the workstations' disk surfaces), but neither were their data blocks scattered all over the disks.

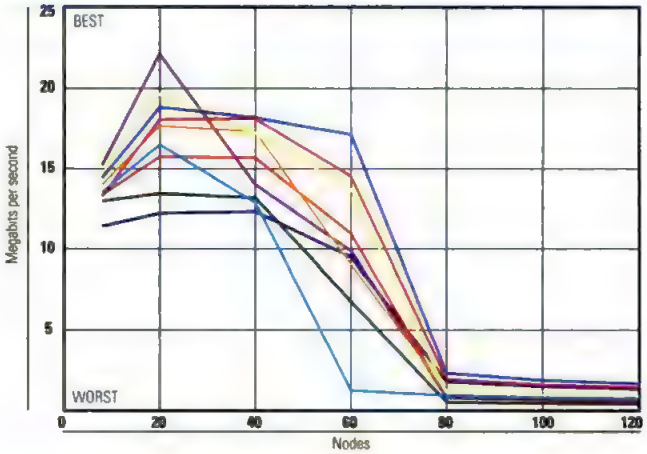
We combined random reads and writes using the above-defined file and block sizes, to simulate the highly random data requests common in large networks with many users simultaneously accessing data in disparate locations on-disk. We used a read/write ratio of 3:1, which we derived by profiling many actual network environments.

NetBench is loaded from the network onto all workstations. One workstation is used to trigger itself and all others to begin data read or write activities almost simultaneously. Test-result calculations are performed at each workstation, and aggregate throughput measurements are collected, calculated, and presented in the accompanying graphs you see presented on these pages.

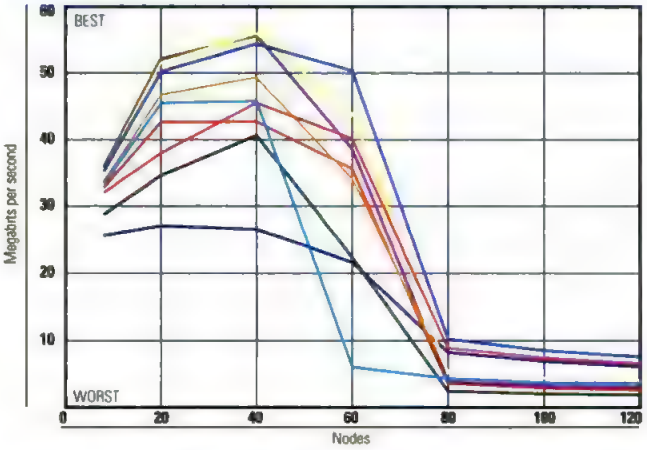
RANDOM READ/WRITE

Acer ALR AST Compaq Dell DEC HP NEC ZDS

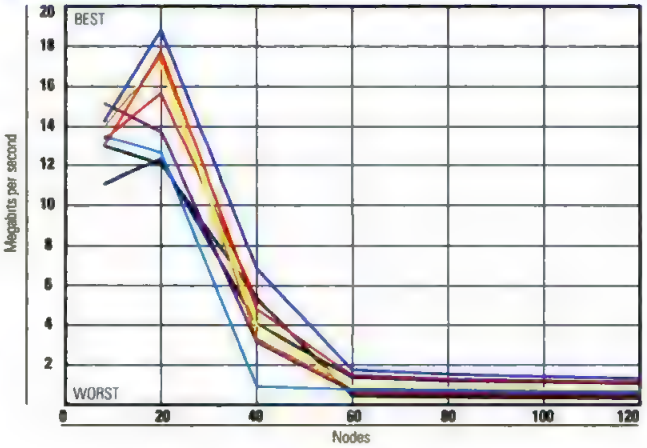
I/O THROUGHPUT (512K files, 512-byte blocks)



I/O THROUGHPUT (512K files, 4K blocks)



I/O THROUGHPUT (1MB files, 512-byte blocks)



Glossary

application server A type of file server optimized for specific tasks, such as acting as the engine for a large database. It generally uses higher-end hardware than typical file servers. A **super server** is a high-performance system usually characterized by advanced multiprocessing features, scalable I/O channels, and a hefty price tag.

bus mastering A technique that allows advanced bus architectures to delegate control of data transfers between the CPU and associated peripherals, allowing network cards greater system bus access and better transfer speeds.

drive array A combination of several hard disks and a special controller, which allows for faster data access with special security and LAN management functions (see *RAID*).

network adapter or **network interface card (NIC)** Cards that effectively function as the backbone of the LAN. Network interface cards come in two varieties. One type is installed at each node on the network, while the other type is installed at the network server. In combination with software drivers, these cards allow nodes to communicate on the LAN.

RAID Redundant Array of Inexpensive Disks; a drive array of low-cost (often IDE) hard disks used by file servers to store LAN and end-user data files. A RAID has one of five data-security levels, plus fault tolerance and other LAN-management features.

SCSI Small computer system interface; a high-speed data exchange interface that can distinguish among up to seven devices on a single connection. Today SCSI is most often used with hard disks, tape drives, and other mass storage media. The interface's only hurdle to mass acceptance has been the lack of a usable standard manufacturers' specification.

SLED A single large expensive disk. Until quite recently, such hard disks were unable to support any RAID features. Some new high-end disk controllers are now allowing one or two large disks to support certain RAID functions; the two most common functions supported are disk mirroring and limited fault tolerance.

Compaq Computer Corp.

Compaq ProSignia 486DX2/66

BY OLIVER RIST

Compaq calls its $12,627 ProSignia 486DX2/66 a "low-cost" server, but the unit didn't really distinguish itself from other servers costing much less. In fact, the ProSignia's only unusual feature is its Insight LAN-management capabilities.

Even a cursory examination shows evidence of the Prosignia's "low-cost" direction. The case is poorly finished both inside and out, with rough support struts that can be a hazard when you work inside the case. The power supply is only 240 watts, and there are no front-panel or case locks.

Inside, you'll see a little more effort, but you still have to weigh what Compaq gives you against what it doesn't. The basics are all there, including a 256K external processor cache. But you can expand RAM to only 128MB, as opposed to 256MB for some competitors.

The Compaq ProSignia 486DX2/66

Compaq claims that you can upgrade easily via an Intel OverDrive chip. The ProSignia has a LIF (Low Insertion Force) socket; in contrast, most of the other tested servers put their CPUs on easily replaceable plug-in cards. Also, with a DX2/66 installed, the next upgrade would be to a Pentium, and it isn't clear right now whether the ProSignia will support such a processor.

Compaq ProSignia 486DX2/66

SUITABILITY TO TASK	
Scalability	FAIR
Security/fault tolerance	EXCELLENT
NIC throughput	EXCELLENT
CPU utilization	EXCELLENT

The ProSignia has 8 drive bays (versus the 11 commonly found on other units) and 7 EISA bus mastering slots (versus 8 or more in many other systems). Compaq touts a Flexible Advanced System Architecture that you may mistake for the highly respected 128-bit Tri-Flex design found in the ultra high-performance SystemPro products. But don't be fooled—the ProSignia uses a 32-bit memory bus that produced standard EISA performance.

Compaq did, however, supply a number of hardware features curiously missing in most of the competition, such as an internal Fast SCSI-2 connector that ran four 550MB SCSI hard disks for a 2.2GB capacity. This arrangement has no RAID support, though that's available on other drive array models that Compaq did not include in this review.

The Insight software, too, has server-management features that are missing in many of its competitors, including re-

FACT FILE

Compaq ProSignia 486DX2/66

Compaq Computer Corp., P.O. BOX 692000, Houston, TX 77069-2000; 800-345-1518, 713-370-0670

List price (tested configuration): $12,627.

Configuration: One Intel 486DX2/66 processor, 32MB RAM with 256K write-back cache, four Hewlett-Packard or Fujitsu 550MB Fast SCSI-2 hard disks, one Compaq Fast SCSI-2 hard disk controller (no cache), one 1.44MB floppy disk drive.

In short: Compaq's definition of a "low-cost" server turned this unit into a badly finished and somewhat stripped-down competitor. Only its bright performance scores, some nice hardware features not found on other tested units, and the ability to add a bunch of higher-end options save it.

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Upgrading Your LAN

Tips on Making Better Connections

Adding a few new employees or even a whole new department? The old Ethernet highway getting a little congested? You can stretch your storage capacity and your data bandwidth, and rev up your throughput without splotching large red marks all over your budget.

Don't jump the gun and automatically buy a higher-end server: If your network needs a quick throughput boost, there are some cheaper and more effective upgrade solutions available to you.

PC Magazine Labs conducted a series of anecdotal tests aimed at discovering which network configurations provided optimal performance under typical 16- and 32-workstation LAN (local area network) configurations. We altered server hardware, processor platforms, memory configurations and the number of connected workstations.

Even though actual workstations numbered only between 16 and 32 nodes, our client stations running NetBench heaped far more stress on the server's disk and memory subsystems than normal.

This is because our tests assumed that all of the nodes are accessing the server at the same time. On the average network, only a fraction of the nodes are active at any given time.

Throughput levels similar to what we reached on our tests would generally be encountered on LANs with 100 users or more.

The bottom line? Fundamentally, for a quick-and-easy network speed boost you have three options:

- Upgrade your server's processor,
- Add system memory, or,
- Add more segments to your LAN.

Of these three upgrading options, adding more server RAM is by far the most inexpensive method, although it still offers a dramatic gain in throughput as well.

BREAKING DOWN YOUR OPTIONS

Adding one or more new segments to your network is the most expensive solution, although it will almost always bring substantially faster throughput. Segmenting your LAN basically means dividing a big LAN into a bunch of smaller ones.

The process involves taking a number of workstations off of a crowded connection and giving them their own connection, either to a new network interface card (NIC) in the primary server or to a router or bridge, or even giving them their own server.

Of the variables that we tested, server RAM made the most noticeable impact on the performance of the server.

In short, you're adding another lane on your data highway. The higher the ratio of lanes to traffic, the faster your traffic flows.

A faster processor showed only modest performance gains on our tests: on average a six to seven percent increase between a 486DX/33 and a 486DX2/66 with large data packets (on our 1K, 2K, and 4K random read/write tests).

However, speedier silicon does give noticeably faster throughput when processing small, mostly cached packets. Again comparing a 486DX2/66 processor to a 486DX/33, we found an average processing increase of about 27 percent using 64-byte and 128-byte packets.

The main processor is less important when large data blocks are transmitted because more emphasis is being placed on the network interface cards and their drivers. PC Magazine Labs used high-speed Madge cards to obtain its results.

Of the variables tested, server RAM made the most noticeable impact on server performance. On PC Labs' test network, performance increased by over 50 percent when we increased the server's RAM from 16MB to 32MB.

The secret is NetWare's cache. With each of the 16 PC Labs test workstations clamoring for a 1MB test file, the 32MB server configuration was able to hold the entire load in its memory cache. The 16MB version, however, often had to make relatively tedious disk accesses.

If your network load has increased, adding a few more SIMM modules is a much cheaper and simpler solution than either replacing the processor or adding new segments.

This is not to say that you should just keep cramming RAM into your servers and expect system throughput to improve with each addition of a new chip or module.

Every performance curve eventually peaks and you'll reach a point where installing extra RAM becomes a waste of time and money. You'll be far better off by taking a long-term view of network management.

If you know that your network's increased load today is only an early indication of even more activity later, the most efficient solution may be to purchase a new server, bridge, or router now and leave the memory push for a later date. It pays to think ahead.

—Oliver Rist

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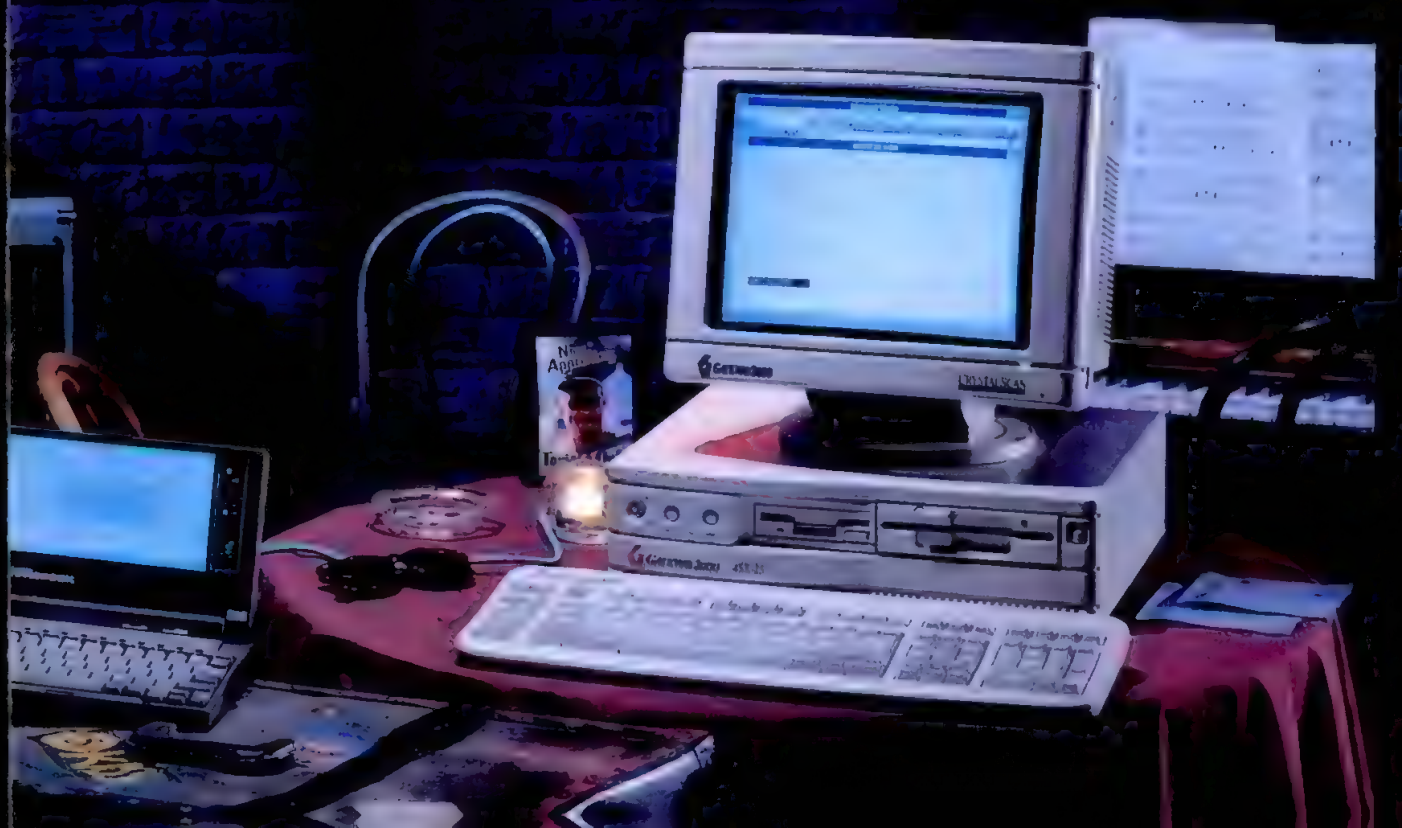

DECpc 450ST

SUITABILITY TO TASK	
Scalability	FAIR
Security/fault tolerance	POOR
NIC throughput	GOOD
CPU utilization	EXCELLENT

The motherboard as well as the CPU module card are manufactured by Intel. The motherboard is similar but not identical to the one used on the ZDS Z-Server 450DE, differing principally in its fewer expansion slots (the DEC unit has six slots; the ZDS system, eight).

The CPU module has hefty heat sinks on the processor, on the cache controller chip, and on the 256K external RAM cache.

The motherboard has only four SIMM sockets; but with 16MB SIMMs, it can hold 64MB. A proprietary memory-expansion board adds 192MB in 16MB SIMMs, for a system maximum of 256MB; when 32MB SIMMs become available, you'll be able to increase memory to 128MB on the motherboard and 384MB on the card for a total of 512MB.

FACT FILE

DECpc 450ST

Digital Equipment Corp., 50 Nagog Park, Acton, MA 01720; 800-722-9332, fax, 800-524-5694

List price (tested configuration): $8,664.

Configuration: One Intel 486DX/50 processor, 32MB RAM with 256K write-back cache, one 1GB DEC RZ24L-E and one 245MB HP C2247 SCSI-2 hard disk, one Adaptec AHA1740A SCSI EISA controller with 512K cache, one 1.44MB floppy disk drive, 254-watt power supply

In short: This server, which is partially manufactured for Digital by Intel, has a fairly low price but offers minimal hard drive or expansion card upgrade options. Digital's use of two mismatched hard drives caused the unit to turn in low Benchmark test scores. The unit may be adequate for smaller networks, but it currently doesn't keep up with the pack.

491 ON READER SERVICE CARD

The DECpc 450ST's network benchmark test scores were pushed down by the system's two disk drives; most other systems had three to eight drives.

The relatively inexpensive DECpc 450ST is fine for small networks. You can easily increase system RAM, but with its small power supply and limited expansion room, it doesn't match the capacity of its competitors.

Dell Computer Corp.

Dell 466SE/DSA PowerLine Server

BY OLIVER RIST

Though Dell's $14,051 466SE/DSA PowerLine Server does not quite fall into the "low-cost server" category, it's more aggressively priced than some of the competition, especially considering the unit's advantages. The unit that we tested offered such features as a cached

Dell 466SE/DSA PowerLine Server

SUITABILITY TO TASK	
Scalability	FAIR
Security/fault tolerance	GOOD
NIC throughput	EXCELLENT
CPU utilization	GOOD

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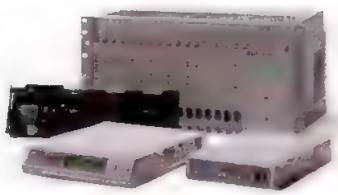

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What the Numbers Mean

What did we find out from subjecting our nine test servers to one of ZD Labs' NetBench tests? First, we discovered that systems with 486DX/50 processors should have a performance advantage over 486DX2/66 systems in reading data from disk cache memory. An inferior disk subsystem or network adapter, however, can easily offset the gains.

The DECpc 450ST, which included two different-size hard disks, or *spindles*, exemplified the type of system that matches a powerful processor with a weak disk setup. Basing a striped server system (a system on which data is split up or "striped" across multiple drives) on two spindles can result in slow sequential access compared with striped systems that have three or more spindles.

If the same amount of data is being accessed randomly from two- and four-spindle striped systems of similar capacity, for example, the heads in the two-spindle system will have to move further out on the disk surface than on the four-spindle system, causing longer wait times.

File-server performance depends more on the disk or network adapter installed than on the CPU. Bus-mastering network and disk adapters further reduce the workload placed on the CPU; all of the tested servers used such adapters.

The **Random Read/Write** test measures the raw speed of random disk access. The servers exhibited high disk-cache hit rates on this test until we loaded them with a certain number of users. The number varied by machine. After each server reached its threshold, the disk subsystem became the main performance bottleneck. This performance "knee," the spot where the throughput curve turns downward, is the most important element to look for in this test. Systems that can maintain high throughput levels and extend the knee the farthest along the *x*-axis are often the best overall performers.

Another significant issue is CPU utilization, a measure of how hard the processor worked during testing. File size is also an important factor, as seen in the performance curves. Throughput is substantially increased with larger read/write request block sizes. The Dell 466SE/DSA PowerLine Server delivered the best throughput across all versions of the random read/write test, but its excellent results are attributable to its four-spindle, 4GB disk subsystem. The disk heads on such a subsystem do not have to move as far out on the disk surface as they do on the 2GB subsystems used in most of the other servers.

The Compaq ProSignia 486DX2/66 delivers a good balance of throughput and CPU utilization. But the ALR ProVEISA VM 4/66d, with its two 1.2GB Maxtor drives, takes a nosedive in throughput, becoming totally disk-bound (very low CPU utilization) with 512K files in various block sizes on a network of 60 users.

The ZDS Z-Server 450DE's throughput peaked at 20 users on the 512-byte block portions of the test. This performance is probably attributable to its DX/50 CPU, because most reads are performed from disk cache.

We also ran the Random Read/Write test separately with 2MB, 4MB, and 8MB files on a network of 120 users. The results show significantly reduced throughput; the random-access speeds of the server disk subsystems are reflected on the test score graphs.

With more than 60 clients running 512K files, and with between 20 and 40 users running 1MB files, most systems hit a "disk wall." At this performance barrier, requests are no longer mostly serviced from disk cache. With more than 32MB of system memory, you would probably experience better peak performance for a large number of users.

How We Tested

THE SETUP

The ZD Labs networking team in Foster City, California, conducted file-server benchmark testing under the supervision of networking specialist David Frerichs. ZD Labs has a large, flexible network that can accommodate more than 200 active workstations. For the midlevel class of server under examination, we chose to use 120 stations as our maximum load.

We installed Novell's NetWare 3.11 on all servers and requested that vendors include 32MB of RAM and anywhere from 1.2GB to 2.0GB of disk storage. Dell did not market a disk subsystem with less than 4GB, so we used its 4GB drive array (four 1GB drives). We configured this array so that it appeared to NetWare as a 2GB volume for testing, but with double the disk capacity of the other tested systems, the Dell system still had an advantage over a true 2GB subsystem.

Even the large-file runs of our disk test, which force the largest radial displacement of the heads, move the drive heads on the Dell system no more than one-quarter of the maximum distance in its 4GB drive array. The Dell system performed unusually well, partly as a result of this configuration.

NetWare 3.11 was installed with 4K disk block sizes and a maximum physical receive-packet size of 4,202 bytes. NetWare disk-cache RAM size defaulted to approximately 28MB in all servers. MAC-level (media-access control—level) packet sizes were left at default values on all network adapters; each was capable of supporting up to 4Kof data per 802.5K frame. We did not use burst-mode IPX.

All tested systems included at least two hard disks, but only three—the units from Acer, AST, and Dell—were configured with true hardware RAID (Redundant Array of Inexpensive Disks) drive subsystems (for more information on RAID, see "RAID Technology: How Safe and How Inexpensive?" on page 194). We set up all hardware RAID subsystems for RAID level 0, which has striping without parity and is the fastest RAID configuration. We set up the rest of our tested units with their multiple SLED (single large expensive disk) drives as one large logical NetWare partition using NetWare's own striping feature.

Portables And Co

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FACT FILE

Dell 466SE/DSA PowerLine Server

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; 800-289-3355, 512-338-4400; fax, 800-727-8320

List price (tested configuration): $14,051.
Configuration: One Intel 486DX2/66 processor, 32MB RAM with a 128K write-through cache, four 1GB DEC 3105 SCSI-2 hard disks with 1.5MB buffer, DSA hard disk controller, dual 1.2MB/1.44MB floppy disk drive, 350-watt power supply.
In short: Though the Dell 466SE/DSA PowerLine is slightly expensive, Dell obviously put a lot of effort into its design. Busy network administrators will certainly appreciate the unit's 11 drive bays, its top-mounted cable connections, and its convenient guide to cabling. From the case to the drive array, this one's a winner.

492 ON READER SERVICE CARD

4GB disk array and a system case that is designed to please harried network administrators.

In a departure from lookalike tower case design, the PowerLine's appears to have the network manager's duties in mind. First, Dell placed the expansion slots so that the rear port brackets, covered by a convenient plastic access door, terminate on *top* of the system. The unit also features a useful cabling guide, which helps avoid messy external cable jungles.

The case design on the Dell 466SE/DSA PowerLine Server appears to have the network manager's duties in mind.

Internal access is simplified as well with a shielded side door. Drive space is maximized to 11 drive bays, though one of our test unit's bays was occupied by an extra fan that blew air onto the 4GB drive array—a nice ventilation touch if you can spare the room. Another fan is in the 350-watt power supply.

Dell gave as much thought to what a

SUMMARY OF FEATURES CONTINUES

File Servers

List price (*PC Magazine* configuration) For this review of file servers, we requested a configuration that included EISA, MCA, or another advanced bus architecture; 32MB of RAM; at least 1.2GB of total data storage; and NetWare certification. The microprocessor had to be an Intel 486DX/50 or 486DX2/66.

Unless otherwise noted, all table entries refer to the range of options available in the systems reviewed.

Base price Because of the wide variety of options available with these workhorse products, we've also listed the base price of these machines. This base figure represents the price of the most stripped-down configuration the vendor will normally sell. Though this varies among vendors, this price generally includes at least a case, a system board, and 1MB of RAM.

Installable RAM on motherboard/card indicates the maximum amount of memory that can be installed using a combination of motherboard-mounted memory chips and proprietary memory expansion cards.

CPU bus structure All these systems use an EISA I/O bus architecture. In addition, some of the servers have proprietary bus architectures that allow the CPU to communicate with system memory or the external SRAM cache (if one is installed) at a 64-bit transfer rate.

The main advantage **32-bit bus-mastering slots** provide is that they let intelligent EISA or MCA expansion cards take direct control of the CPU to allow data transfer at up to 486-burst-mode speed. But systems usually contain at least a few **non-bus-mastering slots** as well.

Also, the system may have **other slots,** which can be proprietary expansion slots for system hardware, such as additional processor plug-in cards (for systems capable of symmetric multiprocessing) or memory cards.

Local-bus slots are designed to either proprietary specs or the VESA VL-Bus specification. They allow special expansion cards to process data at the same clock speed as the CPU.

So far, mainly graphics cards are taking advantage of this technology, but some manufacturers are already using local-bus connections for some of the hard disk controllers in their relatively high-performance PCs.

RAID levels supported A Redundant Array of Inexpensive Disks (RAID) allows various network storage functions, such as disk mirroring or duplexing, parity checking, or disk striping.

A hierarchy of RAID levels allows different combinations of these and other functions, some through hardware and some through software. (For more information, see the sidebar "RAID Technology: How Safe and How Inxpensive?" on page 194 of this issue.)

Certified for DOS, NetWare, and Unix We indicate whether the system supports the DOS, NetWare, and Unix operating systems. In addition, we list **other compatible operating systems** such as Microsoft Windows NT, OS/2, Banyan's VINES, and others.

Fault-tolerant components indicates whether the system has redundant hardware elements (such as multiple hard disks) that will allow the server to continue functioning even if one or more elements fail. Some products even allow you to repair faulty elements without taking the system off-line.

System management notification indicates how the system alerts the network administrator of problems—either by an on-screen message or by a remote warning. A remote warning might come from an LCD or LED screen on the CPU, from an audio alarm, such as a beeper, or in some other manner.

For example, some servers that are equipped with a modem and remote-notification software can dial a preset emergency number to alert the system administrator of a major problem.

Temperature sensor Some servers are equipped with an internal sensor that measures the case's interior temperature. Should this rise beyond a certain point, the most basic sensor will cause the internal fan either to start spinning or to spin faster.

Some machines are equipped with more sophisticated mechanisms that will not only activate the fan but can also be configured to notify the network administrator that the system is overheating. Some can even shut the system down safely in extreme cases.

SUMMARY OF FEATURES

File Servers

In alphabetical order by company name

■ = YES □ = NO

	AcerFrame 1000/50	ALR ProVEISA VM 4/66d	AST Premium SE 4/66d	Compaq ProSignia 486DX2/66	Dell 466SE/DSA PowerLine Server	Digital DECpc 450ST
List price (PC Magazine configuration)	$12,834	$11,434	$16,850	$12,627	$14,051	$8,664
Base price	$5,995	$3,095	$4,795	$5,459	$7,994	$4,719
Output (watts)	350	300	300	240	350	254
Processor and Memory						
Processor	486DX/50	486DX2/66	486DX2/66	486DX2/66	486DX2/66	486DX/50
Maximum processors supported	2	2	1	1	1	1
Installable RAM on motherboard/card	64MB/56MB	256MB/None	None/96MB	128MB/None	128MB/None	64MB/192MB
Installable RAM cache	256K–512K	256K–1MB	256K	256K	128K	256K
Expansion Bus						
CPU bus structure	64-bit proprietary FrameBus	32-bit EISA	Cupid-32	32-bit Flexible Advanced System Architecture	32-bit EISA	32-bit Intel Xpress
32-bit bus-mastering slots	6	6	6	7	6	6
32-bit non-bus-mastering slots	2	2	4	None	2	None
Other slots	Two 64-bit proprietary for CPU/memory	Two 16-bit ISA	None	One 32-bit for NetFlex controller	None	One 32-bit Xpress Bus for optional memory board
Local-bus slots	None	None	None	None	None	None
Disk Drives						
Maximum installable drives	8	12	11	8	10	5
Drive manufacturer/Rated access time	Seagate/12 ms	Maxtor/9 ms	HP/10.5 ms	Fujitsu, HP/11 ms	Digital/15 ms	HP/10.5 ms
Drive array:						
Capacity per drive	250MB	1.2GB	500MB	550MB	1GB	245MB, 1GB
Hard disk interface	SCSI-2	SCSI	Fast SCSI-2	Fast SCSI-2	SCSI	SCSI-2
Hard disk type	EISA SCSI-2	EISA SCSI	EISA Fast SCSI-2	EISA SCSI-2	EISA SCSI-2	EISA SCSI-2
RAID level supported	0, 1, 4, 5	0, 1, 4, 5	0, 1, 5, AST 6 (RAID 0 and 1)	None	0, 1, 4, 5	None
RAID implementation	Hardware	Hardware	Hardware	N/A	Hardware	N/A
Software						
Certified for DOS, NetWare, and Unix	■	■	■	■	■	■
Other compatible operating systems	OS/2, VINES	Microsoft Windows NT, OS/2, VINES	Microsoft LAN Manager, Microsoft Windows, OS/2, SCO Unix, VINES	Microsoft LAN Manager, OS/2, SCO Unix, VINES	Microsoft LAN Manager, OS/2, SCO Unix	DEC Pathworks, VINES
Fault Tolerance						
Fault-tolerant components:						
Processors	□	□	□	□	□	□
Drives	■	■	■	■	■	□
Controllers	■	□	■	□	■	□
Power supply	□	□	□	□	□	□
System management notification	None	None	None	Remote	On-screen, remote	None
Server Management						
Temperature sensor	□	■	□	■	□	□
Warranty	1 year	1 year	3 years	3 years	1 year	1 year
On-site service	Included (90 days)	$9.95 (1 year)	Included (3 years)	Included (1 year)	Included (1 year)	Included (1 year)

N/A—Not applicable: The product does not have this feature

HP Vectra 486/66ST PC Server	NEC PowerMate Express 486DX2/66	ZDS Z-Server 450DE (PC Editors' Choice)
$10,349	$6,266	$9,245
$5,999	$3,449	$5,749
300	388	384
486DX2/66	486DX2/66	486DX/50
1	1	1
64MB/None	64MB/192MB	128MB/256MB
128K	128K	256K
32-bit EISA	32-bit EISA	Strobed Asynchronous Modular Memory
8	6	6
None	4	2
None	One 32-bit proprietary for CPU	One 32-bit for CPU, one 32-bit for memory
VL-Bus	None	None
6	11	8
HP/9.8 ms	Maxtor/12 ms	Fujitsu/12 ms
430MB	525MB	520MB
SCSI-2	IDE, SCSI	SCSI-2
EISA SCSI-2	EISA IDE, SCSI	EISA SCSI-2
1, 3	1	1, 5
Hardware	Hardware	Software
■	■	■
LAN Server, Microsoft LAN Manager, OS/2, VINES	DEC Pathworks, Microsoft LAN Manager, Microsoft Windows NT, OS/2, VINES	Microsoft LAN Manager, NetWare, SCO Unix, VINES
□	□	□
□	□	■
□	□	□
□	□	□
None	None	On-screen
□	□	■
1 year	1 year	1 year
Included (1 year)	Included (1 year)	Included (1 year)

server requires on the inside as it did to what it requires on the outside. Our test system's installed 32MB of RAM can be expanded to 128MB, and the PowerLine's processor comes on an easily upgradable plug-in card. Though Dell didn't support dual processors at the time of this review, it may offer this feature in the near future. Storage was handled by an awesome 4GB disk array that supported all RAID levels except 2 and 3 and also included a 1.5MB disk cache.

On ZD Labs' NetBench, the unit's Random Read/Write test results were excellent, mainly because of the 4GB disk array, which allowed the PowerLine to get away with less disk-head movement than the other machines in this review.

Because we asked the vendors for a hard disk storage level of 2GB and most of the other participants complied, you might think Dell's 4GB setup gave it an unfair advantage. To a degree it did, but, on the other hand, the company does not manufacture a smaller array and this array did arrive in a package priced thousands less than some other entrants.

The Dell 486E/DSA PowerLine Server

ZD Labs' technicians did notice some disturbing behavior from the Dell server when 40 clients were attached to the network. Without warning and at random, network users were disconnected. While Dell gave no explanation, we suspect a conflict between the system's external cache and NetWare's software cache.

The HP Vectra 486/66ST PC Server

Bolstering the unit's server credentials, Dell has added a number of management features, such as drive-failure and data-rebuild utilities, hot drive and drive-controller swapping, and remote notification. Software-based password protection is extensive as well, and, of course, you get the wonderfully illustrated and complete system documentation that Dell is known for. The system is covered by a one-year parts-and-labor warranty.

Hewlett-Packard Co.

HP Vectra 486/66ST PC Server

BY OLIVER RIST

Hewlett-Packard has a deservedly excellent reputation for network products. Although its $10,349 Vectra 486/66ST PC Server managed to pull off adequate scores on ZD Labs' NetBench tests, it lacked many of the features—especially upgrade options—that you've come to expect from high-end systems.

For instance, dual processors were not supported, motherboard RAM extends only to 64MB with no upgrade card available, and the external processor cache is limited to only 128K.

Most of the Vectra's competitors in this test placed their processors on upgradable plug-in cards, for anyone considering dual processors or an eventual upgrade to the Pentium chip. Hewlett-Packard's approach is to place its CPU on the motherboard, making a chip-puller and clock-crystal swap necessary for upgrades.

And, unlike Dell or AST, HP paid little attention to its machine's case; it looks like a typical tower with a difficult-to-replace U-shaped cover. It offers only 7 drive bays, compared with 11 for many of the other systems. Fortunately, HP will be intro-

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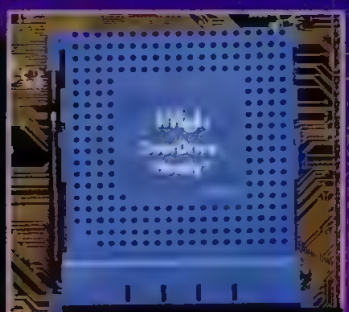

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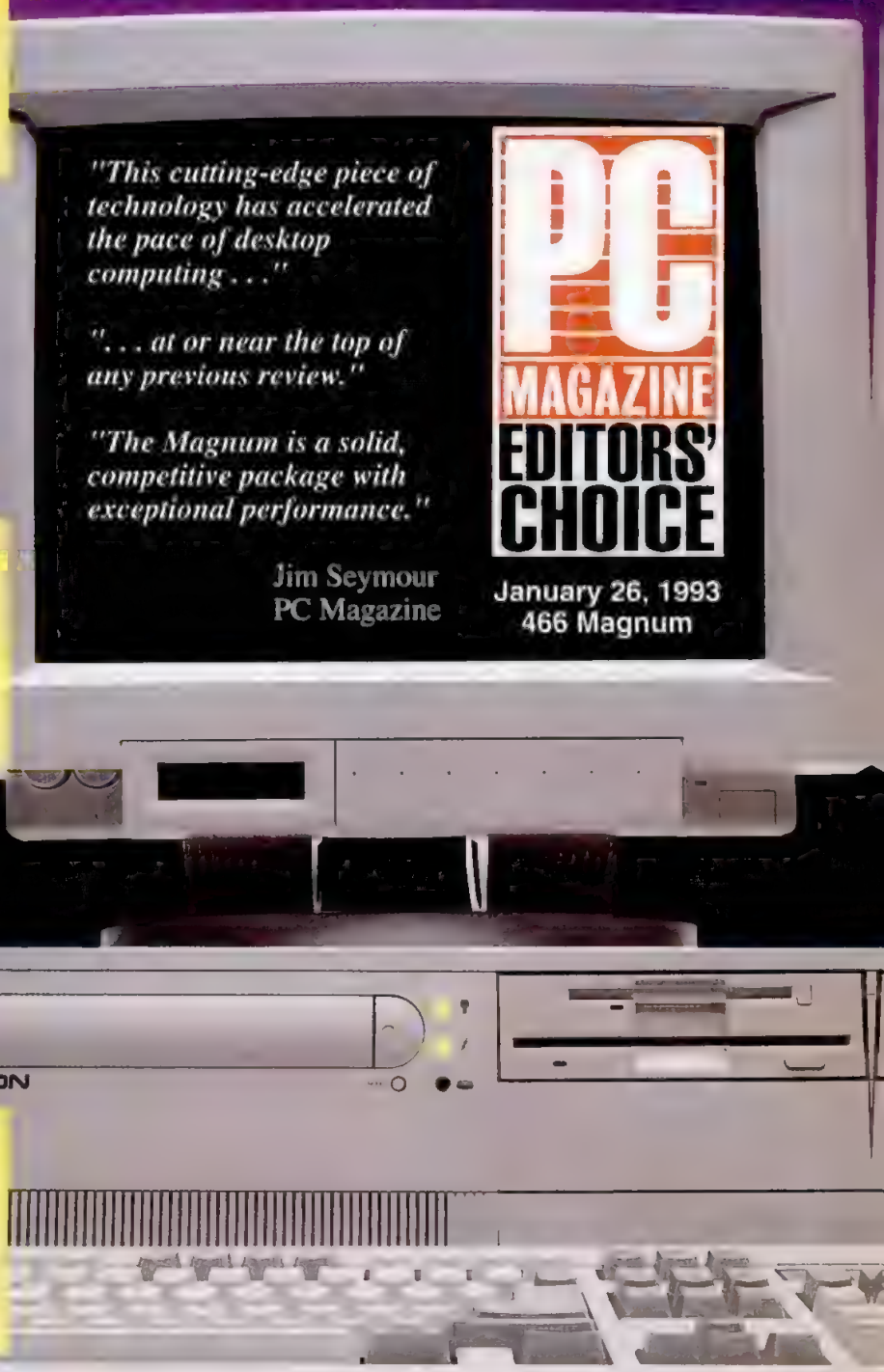
January 26, 1993
466 Magnum



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PC MAGAZINE EDITORS' CHOICE
January 26, 1993
486 Magnum

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FACT FILE

HP Vectra 486/66ST PC Server

Hewlett-Packard Co., 3000 Hanover St., Palo Alto, CA 94304; 800-752-0900

List price (tested configuration): $10,349.

Configuration: One Intel 486DX2/66 processor, 32MB RAM with 128K write-through cache, four HP D1699-60001 430MB SCSI-2 hard disks, Adaptec AHA1740 EISA SCSI controller, 300-watt power supply.

In short: Though the HP Vectra's price looks competitive, upon closer examination you'll find that Hewlett-Packard skimped on some important upgrade and server-management features. This casts a shadow over the unit's solid test scores.

483 ON READER SERVICE CARD

ducing expansions to this line, especially for Pentium configurations. These new machines will have completely redesigned cases with more storage space and will reflect better attention to LAN administration needs.

But the news for the current Vectra isn't all bad. You will find a healthy 300-watt power supply and even eight EISA bus mastering expansion slots. Video is handled through a VESA-compliant VL-Bus extension supported by the S3 graphical user interface accelerator chip set, with 1MB of dedicated VRAM.

New HP Vectra servers will have completely redesigned cases with more storage space and better attention to LAN-administration needs.

You might wonder why a server would need this level of video performance, even when running LAN Manager or Windows NT. Just consider it a pleasant bonus, since it certainly doesn't detract from the system.

System BIOS is flash-upgradable. Four HP D1699-60001 430MB SCSI-2 hard disks combine for 1.7GB of disk storage capable of RAID 1 and 3 via an Adaptec AHA1740 SCSI EISA controller. Most of the better systems in this review handled RAID 0, 1, 4, and 5, however. The Vectra is a step or two behind the leaders in the features race.

On performance, though, the Vectra system held its own. Its Random Read/Write scores were at or near the top.

On dedicated network functions, though, HP fell short again. Features such as server management and fault tolerance were ignored, except for the RAID provisions. We noticed a performance snag when we used the supplied Olicom network interface cards and drivers with the system: Processor use inexplicably jumped to 100 percent with only one client attached to the network.

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HP Vectra 486/66ST PC Server

SUITABILITY TO TASK	
Scalability	FAIR
Security/fault tolerance	POOR
NIC throughput	EXCELLENT
CPU utilization	GOOD

An outdated driver caused the problem; as soon as we replaced the supplied cards with standard Madge network interface cards, the server performed well.

HP has a one-year parts-and-labor warranty with on-site next-day service, but the company falls a little short with this product.

NEC Technologies Inc.

PowerMate Express 486DX2/66

BY BRUCE BROWN

If you want to spend as little as possible on a server that offers good expansion capacity and you don't need terribly high throughput, the NEC PowerMate Express 486DX2/66 is certainly a candidate worth considering.

At $6,226, the PowerMate Express is the least expensive system in this review, although the price does not include network interface cards. Our test unit did come with a 66MHz Intel 486DX2 processor, 32MB of RAM, 128K of external RAM cache, a gigabyte of disk storage, and a disk controller with a 512K cache.

The NEC PowerMate Express 486DX2/66

The PowerMate Express's scores on ZD Labs' NetBench suite of tests argue against using it in a throughput-intensive application, but aside from that limitation, this system appears to be a good product at a good price.

The PowerMate Express 486DX2/66 comes in a large, heavy case that you will wish came with casters if you're going to move it around much. Inside is a mighty 388-watt power supply and room for 11 drives. Three fans—one on the power supply, one near the processor and drives, and one near the memory slots—keep everything cool.

For security, the PowerMate Express has software-based password protection and a keyboard lock on the front of the case. The lock prevents anyone else but you from powering the system up or from removing the case cover to gain access to the components. Once the system is on, however, nothing prevents anyone from resetting the computer or from using a power switch on the rear to turn the system off.

System RAM capacity is 256MB (64MB on the motherboard, 192MB on a proprietary memory-expansion card), but the 128K external RAM cache is not

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FACT FILE

NEC PowerMate Express 486DX2/66

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719-2298, 800-388-8888, 508-264-8000; fax, 508-264-8825

List price (tested configuration): $6,266

Configuration: One Intel 486DX2/66 processor, 32MB RAM with 128K write-through cache, two 535MB Maxtor LXT535S SCSI hard disks, one 1.44MB floppy disk drive, one DPT 2012B2 caching EISA SCSI controller with 512K cache, 388-watt power supply

In short: The NEC PowerMate Express 486DX2/66 proved to be a relatively slow performer on our server throughput tests. It does have some pluses, however: Its extremely low price, 11 drive bays, and 256MB system RAM capacity make it a possible choice for very small networks that have only moderate performance demands

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expandable. Six of the ten EISA expansion slots can hold bus-mastering cards. The PowerMate's video, I/O, and standard IDE floppy controller circuitry are all on a single card that sits in a proprietary slot.

Our test unit came with two 12-ms 535MB Maxtor LXT535S SCSI hard disk drives and a DPT 2012B2 caching SCSI controller with a 512K disk cache. Not an array-type subsystem, this disk assembly relegated the unit to relatively low throughput on the NetBench suite of tests.

NEC PowerMate Express 486DX2/66

SUITABILITY TO TASK	
Scalability	GOOD
Security/fault tolerance	POOR
NIC throughput	GOOD
CPU utilization	GOOD

Some of the PowerMate Express's throughput scores were close to the midrange of the reviewed systems, but other marks fell below that. A faster drive assembly would probably improve system performance but would probably also raise the price.

The PowerMate Express provides a sturdy foundation for a network file server. The power supply, cooling system, and memory expansion are all fine, but compared with the other systems tested, the PowerMate Express's limited external RAM cache and the hard disk setup used in our tested unit held back performance.

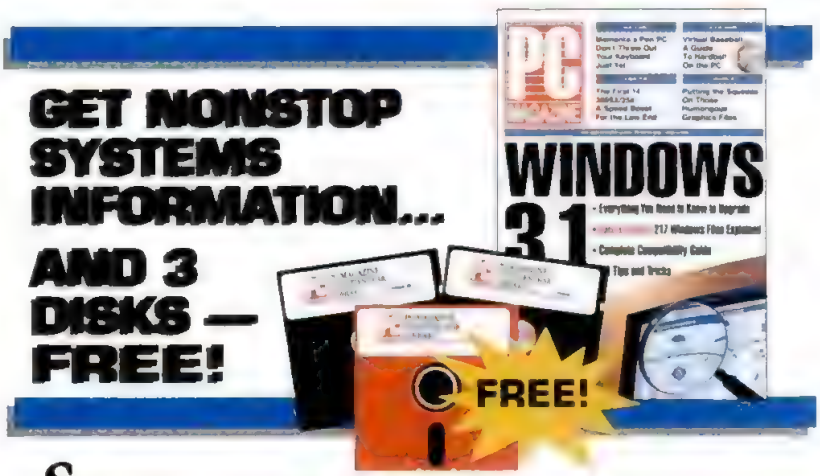
Saved by its extremely low price, which was less than half that of the most expensive machine in this review, the NEC PowerMate Express system is worth considering for less performance-sensitive network applications.

Zenith Data Systems

ZDS Z-Server 450DE

BY BRUCE BROWN

You get lots of performance value with Zenith Data Systems' Z-Server 450DE. The ZDS unit, without network interface cards, lists for $9,245 with an Intel



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486DX/50 processor, 32MB of RAM, and 1.5GB of storage.

In the tested configuration, the ZDS Z-Server achieved better-than-average performance on the network throughput portion of ZD Labs' NetBench tests. The Z-Server is a good balance of price, performance, expandability, and security. And at less than $10,000, it's a bargain.

The ZDS Z-Server 450DE

The Z-Server's motherboard, designed and built by Intel, comes installed in a spacious case. A modular processor card includes the CPU, an Intel 495 cache-controller chip, and a fixed-capacity 256K external RAM cache, all with large heat-sink covers. According to ZDS, the unit can be upgraded to a Pentium processor when the chip becomes available.

ZDS Z-Server 450DE

SUITABILITY TO TASK	
Scalability	GOOD
Security/fault tolerance	FAIR
NIC throughput	EXCELLENT
CPU utilization	GOOD

The Z-Server can support a maximum of 128MB RAM on the motherboard and 256MB on a memory-expansion card for a system maximum of 384MB RAM, the highest RAM capacity of the reviewed servers. The motherboard's expansion bus has eight 32-bit EISA slots, six of which can accept bus mastering cards.

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This controller connects to a SCSI disk-distribution module located just above the eight internal drive bays. The test unit came with three 12-ms 520MB Fujitsu M2624SA SCSI-2 hard disks.

To connect eight drives, you'd need to use an additional motherboard expansion slot for a second controller. In addition to the internal drive bays, the unit has three externally accessible drive bays.

The system case includes front-panel door locks to prevent accidental power loss or resets, and a recessed rear power switch. A second side-panel door comes with a lock that restricts access to the system's components.

The case design has space for air flow between the CPU module card, the memory area on the motherboard, and the expansion cards. Standard power and cooling features include a 384-watt power supply and a thermostatically controlled fan.

The ZDS computer's Random Write/Read test scores were midrange to excellent for the tested systems. With room for 11 disk drives, 384MB of RAM, and a solid but well-ventilated case, the Z-Server 450DE adds up to a good buy with no drawbacks.

The system's NetBench test results suggest that you will enjoy good network response times, and the Z-Server 450DE's security and reliability features should offer you peace of mind. □

PC MAGAZINE EDITORS' CHOICE

FACT FILE

ZDS Z-Server 450DE

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List price (tested configuration): $9,245.

Configuration: One Intel 486DX/50 processor, 32MB RAM with 256K write-back cache, three 520MB Fujitsu M2624SA SCSI-2 hard disks, one Adaptec AHA1740A SCSI EISA hard disk controller, SCSI-2 hard disk distribution module, one 1.44MB floppy disk drive, 384-watt power supply.

In short: The ZDS Z-Server 450DE is a great performer for the money, with impressive memory-expansion (384MB maximum) capability. With its modular CPU card, the unit can even be upgraded to a Pentium chip when it becomes available. The Z-Server also comes with a solid case and adequate security features.

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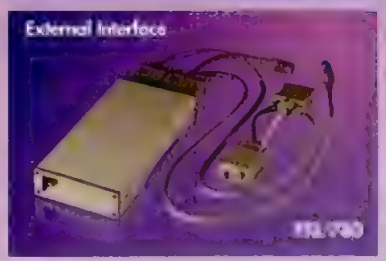

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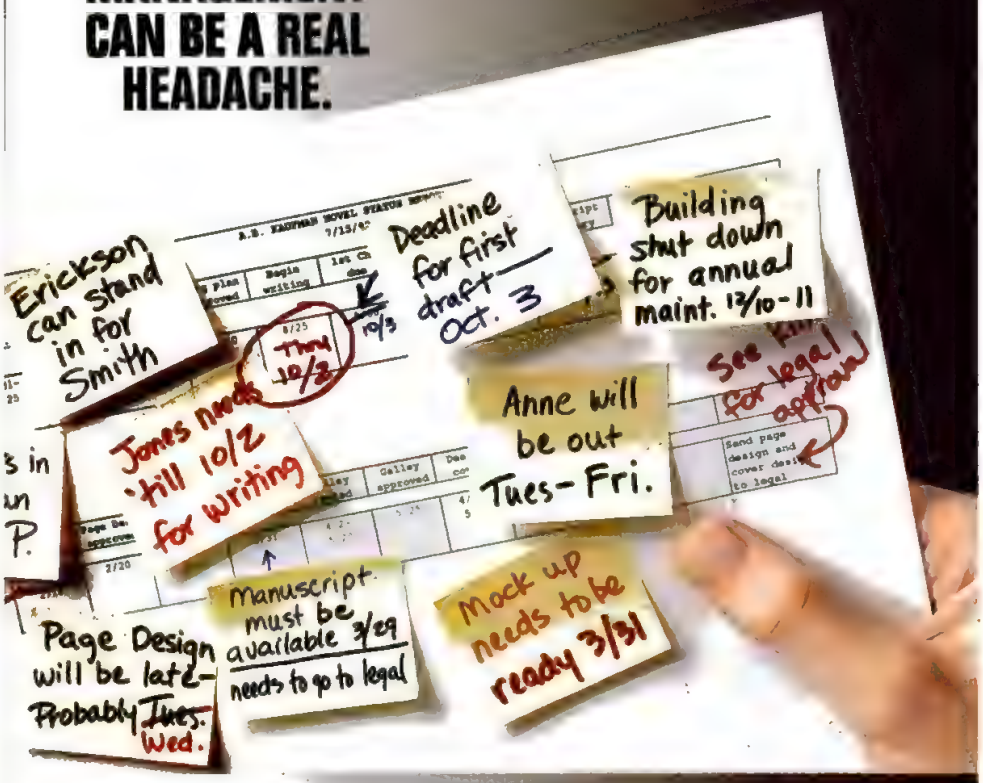

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STATISTICAL ANALYSIS

Stat of the Art

Born on the mainframe computer a generation ago, statistical analysis software has migrated to the PC platform, big time.

by Sheryl Canter

The very word *statistics* turns most people off. Yet more and more businesspeople today need statistics to do their work. Direct marketers use statistics to target mail recipients, analyze who is buying their product, and test the effectiveness of alternative mail pieces. Banks use statistics to determine which potential customers are good credit risks. Investment consultants advise customers on the optimal portfolio mix by using statistics to model expected profits. The list goes on.

Today's PC hardware provides a powerful and affordable platform for many kinds of statistical analysis. Better yet, today's menu-driven packages, with their built-in data editors and extensive on-line help, ease the way for analysts at all levels of expertise.

There are many kinds of statistics packages on the market; a great many of these are

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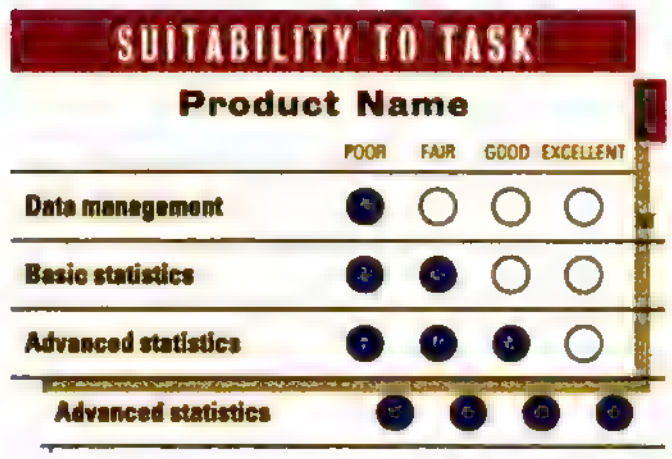
Illustration by Randy Lyhus

Suitability to Task: Statistics Software

Statistics software for the PC must fulfill many of the same objectives that it fulfills on the mainframe: heavy-duty data analysis and a wide breadth of statistical functions. One important difference is that PC users expect both power and ease of use from their software. To perform well on our tests, these packages had to display almost equal parts of power, accuracy, flexibility, and usability.

We presented our reviewers with four sample scenarios to test each product. Elements of each scenario tested the suitability of the application for the occasional user as well as for the advanced statistician. The reviewers then rated the programs in the areas of data management, basic statistics, and advanced statistics.



Data management is a crucial component of statistical analysis. The ability to handle multiple files was a requirement for inclusion in this review; accordingly, our reviewers assessed the depth and sophistication of each package's multiple file–handling capabilities. The best packages can read many different data formats and can store data in a proprietary "system file" that speeds processing and logs file management history. Superior packages also contain a full-featured scripting language, with support for arrays, looping, and branching. Dedicated syntax to ease variable recoding is a plus.

Basic statistics includes descriptive statistics such as means, cross-tabulations, box-and-whisker plots, range measures, and variability measures, along with univariate hypothesis testing, which includes such procedures as t-tests, chi-square tests, and simple regression and correlation. Since these are the procedures most likely to be run by nonstatisticians, ease of use is especially important. The best packages let you run basic statistics entirely from menus and pick lists. They also include extensive on-line help.

For **advanced statistics,** we focus on multivariate hypothesis-testing procedures. The procedures often include assumptions about the distribution of raw data. The package should have a broad spectrum of advanced statistical tests to choose from, and the procedures themselves should include the capability of testing underlying assumptions. The best packages for advanced statistics support interactive graphics for detecting and eliminating outliers. We also consider the efficiency of the packages' computing algorithms, along with the number of variables and records each package could handle.

highly specialized. We looked at general-purpose statistics packages that can accommodate the needs of casual users and experts alike. We further limited our reviews to products that can provide a means for manipulating data (data "cleaning" and "recoding") and have the ability to merge data from two separate files into one new file for analysis.

Serious data analysis almost always requires the analyst to "massage" the data—that is, look at it this way and that until whatever useful information it contains is revealed. During data cleaning, typos and other errors are identified and removed. Data may also need to be reorganized, or recoded, to be most useful. For example, an income variable may originally contain actual yearly income, but preliminary analysis might indicate that it should be recoded into three categories: low, medium, and high.

Even with our selective focus, the range of statistics offerings here is broad and varied. Some packages offer only minimal programming capabilities; others provide a command language with features such as looping, branching, and arrays. Still others go further to offer a macro language for automating repeat execution and combining several procedures into one statement. A few, such as the latest SPSS and SAS products, provide a special-purpose programming language with matrix algebra functions for writing your own procedures. One product we looked at, S-Plus, is actually a high-level programming environment for writing your own statistical routines.

FROM MAINFRAMES TO PCs

Several of the more extensive packages in this story, such as the SPSS, SAS, and BMDP offerings, began their lives on mainframes and were later ported to minis and then micros. A package available on multiple platforms is a more flexible tool than a single-platform package. For example, you can produce frequency and cross-tabulation tables using the full population on the mainframe and then create a sample data set for further analysis on the PC. Ideally, the mainframe and PC versions use the same command syntax; all of them here do, with the exception of SPSS/PC+—the first statistics package ported from the mainframe. (The OS/2 and Windows versions of SPSS correct this problem, however.)

Most cross-platform products also offer a portable file format for moving data between platforms. As data is read into the program, it is converted to an internal

Our Contributors: DAVID ABELS heads a consulting practice specializing in business research, public relations, advertising, and marketing consulting. GRANT BLANK is an independent consultant specializing in statistical analysis and database management. He edited a special issue of *Computers and the Social Sciences,* which was devoted to reviewing full-featured statistical software. SHERYL CANTER is a former associate editor of and frequent contributor to *PC Magazine.* RICHARD GOLDSTEIN, Ph.D., is a statistical consultant with Qualitas Inc. He edits the software-review section of *The American Statistician.* LORI GRUNIN is a former associate editor of and frequent contributor to *PC Magazine.* JOSEPH HILBE, Ph.D., is vice president of research and director of biostatistics at the Health Finances Institute in Pennsylvannia, and an adjunct professor of sociology. CHARLES KADUSHIN is a professor of sociology and psychology and an expert on social networks, methods, and survey research; he is currently involved in organization studies. DAVID RINDSKOPF, Ph.D., is a professor of educational psychology and psychology who researches and teaches applied statistics. TED STEVENSON was the associate editor in charge of this story, and BEN GOTTESMAN was the project leader.

file format (a *system file*) for processing. Along with the data itself, system files contain descriptive information such as when and how the data set was created, variable labels, and value labels. System files can be read in much more quickly than text files since they don't have to be converted for processing, and they save you from having to respecify the record layout and data descriptions.

Another issue in a cross-platform environment is the ability to read data from many sources. It wasn't long ago that most statistics packages could read only fixed and delimited text files. Today, statistics packages can import data in almost any form: hierarchical data, grouped data, SQL (structured query language) databases, .DBF files, spreadsheet formats, and more. This can be a huge time saver for businesspeople who must extract data from many sources for analysis.

PC GRAPHICS POWER

Not surprisingly, the packages in this roundup with the best graphics capabilities—the Systat and Statgraphics packages—were written specifically for the PC. The visual representation of data is an important part of data analysis. A scatterplot or line graph lets you instantly detect anomalies, patterns, and trends. The best packages let you interact with a chart as part of the analytic process itself.

Regression analysis, used to guess about information you don't have on the basis of information you do have, is a good example of a widely used statistical procedure in which charting plays an integral role. For example, you might use household income and number of dependents to predict whether or not a potential customer will be a good credit risk. You could do this by identifying a representative group of people and collecting some information about them: income, number of dependents, and whether or not they promptly pay their bills. A scatterplot of the data might suggest that people with higher incomes are better about paying their bills; to quantify how much better, you'll need to run a regression.

But let's say that one person in your study doesn't fit the mold; he makes $100,000 a year, has no dependents, but is rather casual about paying his bills. In

EDITORS' CHOICE

- **SPSS for Windows**
- **Systat for Windows**

Statistics is a many-faceted discipline: Analysis of survey data, analysis of designed experiments, and econometric and related modeling techniques are all major branches of the statistics tree, each with a profusion of subbranches. Social scientists, marketers, biological scientists, medical researchers, economists, financial planners, and agricultural researchers, among others, all employ statistical analysis in their work, and the needs of each group are different.

Picking one statistical software package to meet the needs of such a diverse collection of professionals is a tall order. However, our consensus is that the needs of a very broad spectrum of statistics consumers will be well-covered by our *two* Editors' Choices: SPSS for Windows and Systat for Windows. While these two packages are not fully comparable, their strengths complement each other. Both of these Windows products are particularly easy to learn and use, compared with the general run of statistics packages.

By virtue of its impressive breadth, SPSS stands as the tool for hard-core statisticians performing heavy-duty number-crunching on powerful systems: There is practically nothing it can't do. And to cover the exceptions, it offers the Matrix language, in which users can write extensions.

SPSS' greatest strength is in analysis of categorical data. It offers strong regression procedures. Support for designed experiments and econometric modeling is less extensive. The menu-and-dialog-box-based interface and powerful, spreadsheet-like data editor serve to flatten the learning curve dramatically. The data-format compatibility is second to none.

Systat for Windows offers an admirable balance of power and ease of use. It's probably the perfect statistical tool for more casual users: those who may own a 386/33 with a 200MB hard disk and really want to understand how to run a T-test that will show them the way (and means).

Systat's statistical algorithms, in many cases the products of well-known statistical professionals, are exceptionally efficient and accurate. Systat's linear models procedure is arguably the best software for analysis of designed experiments offered by any package. (By the same token, Systat is not the package of choice for handling survey and marketing data—or analysis of large data sets generally.) Also impressive is the package's graphical prowess. Both in extent and in quality, Systat's graphing abilities provide a powerful supplement to its statistical procedures.

Systat is perhaps less demanding of hardware resources (memory, disk space, and processor power) than any other product in the roundup. (SPSS, by contrast, is one of the more hardware-intensive.) The result is a particularly effective blend of features, usability, and performance.

Statgraphics Plus, from Manugistics, is close on the heels of our two Editors' Choices. It's a fully menu-driven package with strong, interactive graphics capabilities, but a bit too burdened with limitations (such as file handling—one record per case, lack of standard statistics procedures such as MANOVA and logistic regression, and the lack of a command option) to share the dais. Even so, we mention it honorably as a product that will work well for many users.

the scatterplot, the point representing this person—an *outlier* in statistical terminology—would be far from the other data points. Is he an eccentric, or was there a data-entry error? You'd get more accurate results if you didn't include him in your analysis. But how do you go about identifying the data point and eliminating it? The traditional way is to write program code to identify the outlier, eliminate it from the active data set, and run your analysis again. With interactive graphics, you can do it visually.

FEATURES PLUS

Learn more about PC statistical software from a discussion in ZiffNet's Executive's Online forum, April 26-30, hosted by Sheryl Canter and featuring representatives for the software packages reviewed here. To participate, type GO ZNT:EXEC from any CompuServe prompt.

USER-FRIENDLY STATISTICS?

Today's statistics packages are generally menu driven, or at least this is an option. Sometimes only a portion of the feature set is available through menus, and to access advanced features you must type out the commands. The best packages, such as the Systat and SPSS products, log the command equivalents of the menu options you choose so that you can quickly run the procedures again. Others, such as the Statgraphics packages, rely completely on menus and have no facility for submitting commands. This is a serious disadvantage if you need to rerun the same set of procedures with minor variations or adjustments. Rather than bringing up a command log and selecting the Run option, you are forced to snake through what may be a long series of menus and dialog boxes each time you make a change.

Another variant that is particularly appealing to those who started off in the mainframe world is the ability to run in batch mode rather than in interactive mode. In batch mode, you prepare a command file using a text editor and then submit it to the statistics engine without ever launching the program. The Systat and SPSS packages provide this option.

Many packages now include spreadsheet-like data editors, which were once uncommon extras. Here, these include the Statistica, P-Stat, and Statgraphics packages. Data editors let you sort, recode, and perform other data-management tasks without writing commands. As with menu-driven procedure selection, some packages will write the command equivalents of the data-management tasks you perform to a command log for easy reexecution.

WINDOWS-BOUND

Statistics packages are moving to Windows. SPSS and Systat recently released Windows versions of their packages; StatSoft is working on a Windows version of Statistica, and SAS for Windows is in beta at the time of this writing. The new Windows packages boast superior graphics and are among the easiest to use of all the packages we looked at.

With Systat for Windows, you can view data and graphics simultaneously and make direct, WYSIWYG annotations on a chart. SPSS for Windows has a comprehensive menu system, and its built-in graphics module can produce high-resolution 3-D charts, which can be rotated in virtual space. Another welcome feature in the Windows packages is extensive use of the Windows help system, which lets them easily offer context-sensitive help on statistical procedures and program usage.

Statistics packages are expensive, tending to range from several hundred dollars into the thousands. Most vendors, though, offer substantial discounts to academic institutions. Most of the packages here are sold as base systems with optional modules that you can purchase as needed.

There can be a hidden additional cost: the high-end hardware needed to run these packages. SPSS for Windows requires a minimum of 4MB of memory but runs best with much more. And with its extensive on-line help, the package can take over a sizable chunk of your hard disk. Other products make do with a minimum of hardware by stripping out all but the essential features and using efficient computational methods.

Carefully weigh features, hardware requirements, and prices of these products in order to make an informed choice.

SUITABILITY TO TASK

BMDP/386 Dynamic

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	●	○
Basic statistics	●	●	○	○
Advanced statistics	●	●	●	○

BMDP Statistical Software Inc.

BMDP/386 Dynamic

BY RICHARD GOLDSTEIN

BMDP/386 Dynamic is the current top-of-the-line offering from BMDP Statistical Software. The entire suite consists of 43 statistical programs and three program utilities (Plot, Data Manager, and Data Entry). The cost for 386 Dynamic is $2,695 ($995 for academics), and the cost for the standard version (PC-90) is $2,195 ($495 for academics). If you want, you can start with a smaller subset of 386 Dynamic, priced at $995, and add programs at prices ranging from $75 to $150. Considering BMDP products' high quality and accuracy, these prices are not unreasonable. And they may be especially attractive for those who require the broad range of statistical techniques, numerous options, and strong data-management abilities that BMDP products provide.

Unfortunately, BMDP has made only marginal progress in making its software easier to use or in alleviating its products' traditionally weak graphics. The forthcoming release, which should be on the shelves by the time this review appears, should change some of that. We were given a sneak peak at beta documentation for the next release, and it looked promising. Among the new version's expected features are a new, intelligent, interactive, menu-driven interface called Mentor. The new release promises high-resolution graphics, and users will be able to produce a graph without first running a statistical procedure. Also, some of the graphs should be publication quality, and results will be exportable to graphics and word-processing software. But there will still be no three-dimensional graphing, no brushing, and no spinning or rotating. Also, users won't have the ability to

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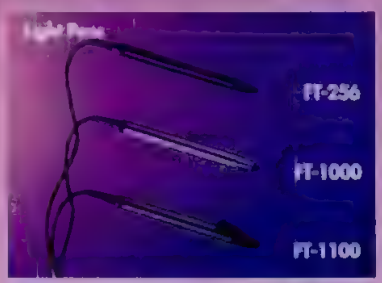

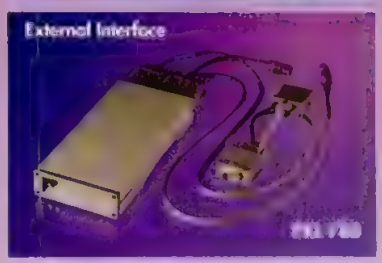

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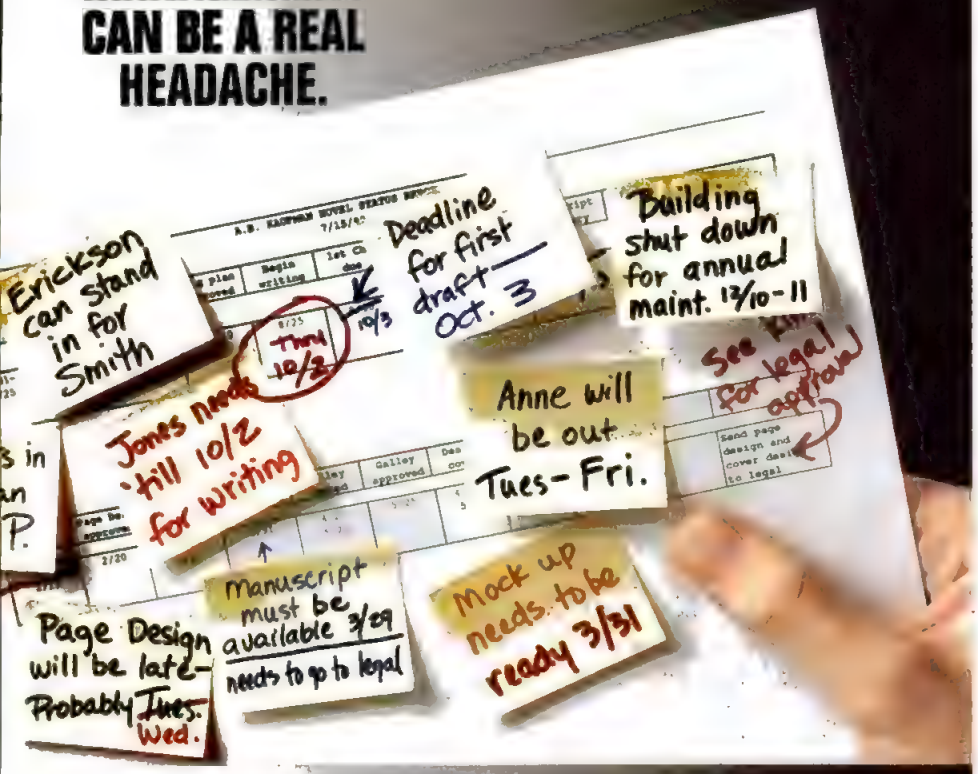

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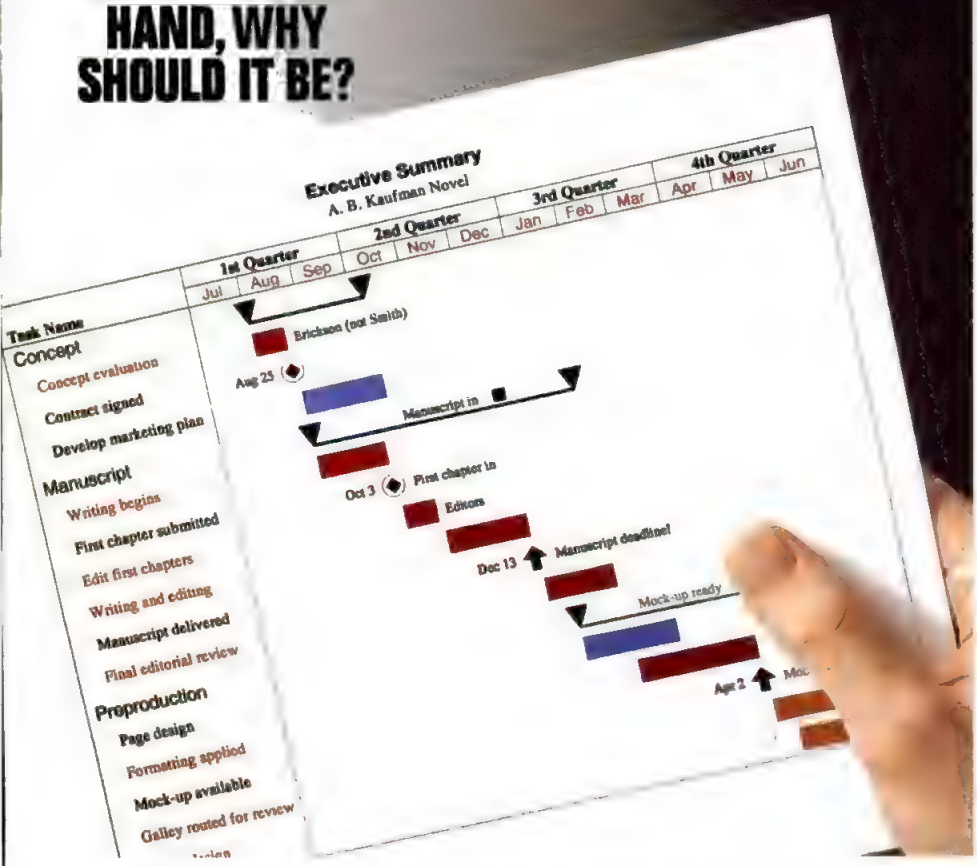

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8. Dell was ranked Customer Satisfaction Leader for IBM-Compatible PC's in the J.D. Power and Associates Computer End-User Satisfaction Study.**
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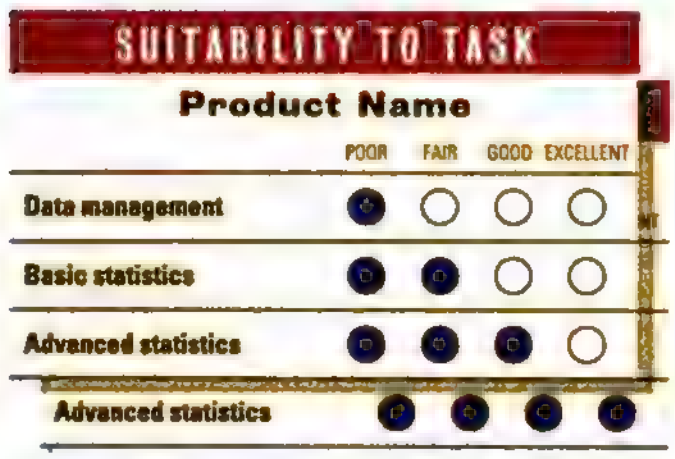
Listing and index scores of all above industry average PC companies are (1) Apple 124, (2) Dell 116, (3) CompuAdd 109, (4) AST 108, (5) Gateway 107, (6) Hewlett-Packard 106, (7) Compaq 103

Suitability to Task: Statistics Software

Statistics software for the PC must fulfill many of the same objectives that it fulfills on the mainframe: heavy-duty data analysis and a wide breadth of statistical functions. One important difference is that PC users expect both power and ease of use from their software. To perform well on our tests, these packages had to display almost equal parts of power, accuracy, flexibility, and usability.

We presented our reviewers with four sample scenarios to test each product. Elements of each scenario tested the suitability of the application for the occasional user as well as for the advanced statistician. The reviewers then rated the programs in the areas of data management, basic statistics, and advanced statistics.

Data management is a crucial component of statistical analysis. The ability to handle multiple files was a requirement for inclusion in this review; accordingly, our reviewers assessed the depth and sophistication of each package's multiple file–handling capabilities. The best packages can read many different data formats and can store data in a proprietary "system file" that speeds processing and logs file management history. Superior packages also contain a full-featured scripting language, with support for arrays, looping, and branching. Dedicated syntax to ease variable recoding is a plus.



Basic statistics includes descriptive statistics such as means, cross-tabulations, box-and-whisker plots, range measures, and variability measures, along with univariate hypothesis testing, which includes such procedures as t-tests, chi-square tests, and simple regression and correlation. Since these are the procedures most likely to be run by non-statisticians, ease of use is especially important. The best packages let you run basic statistics entirely from menus and pick lists. They also include extensive on-line help.

For **advanced statistics,** we focus on multivariate hypothesis-testing procedures. The procedures often include assumptions about the distribution of raw data. The package should have a broad spectrum of advanced statistical tests to choose from, and the procedures themselves should include the capability of testing underlying assumptions. The best packages for advanced statistics support interactive graphics for detecting and eliminating outliers. We also consider the efficiency of the packages' computing algorithms, along with the number of variables and records each package could handle.

highly specialized. We looked at general-purpose statistics packages that can accommodate the needs of casual users and experts alike. We further limited our reviews to products that can provide a means for manipulating data (data "cleaning" and "recoding") and have the ability to merge data from two separate files into one new file for analysis.

Serious data analysis almost always requires the analyst to "massage" the data—that is, look at it this way and that until whatever useful information it contains is revealed. During data cleaning, typos and other errors are identified and removed. Data may also need to be reorganized, or recoded, to be most useful. For example, an income variable may originally contain actual yearly income, but preliminary analysis might indicate that it should be recoded into three categories: low, medium, and high.

Even with our selective focus, the range of statistics offerings here is broad and varied. Some packages offer only minimal programming capabilities; others provide a command language with features such as looping, branching, and arrays. Still others go further to offer a macro language for automating repeat execution and combining several procedures into one statement. A few, such as the latest SPSS and SAS products, provide a special-purpose programming language with matrix algebra functions for writing your own procedures. One product we looked at, S-Plus, is actually a high-level programming environment for writing your own statistical routines.

FROM MAINFRAMES TO PCs

Several of the more extensive packages in this story, such as the SPSS, SAS, and BMDP offerings, began their lives on mainframes and were later ported to minis and then micros. A package available on multiple platforms is a more flexible tool than a single-platform package. For example, you can produce frequency and cross-tabulation tables using the full population on the mainframe and then create a sample data set for further analysis on the PC. Ideally, the mainframe and PC versions use the same command syntax; all of them here do, with the exception of SPSS/PC+—the first statistics package ported from the mainframe. (The OS/2 and Windows versions of SPSS correct this problem, however.)

Most cross-platform products also offer a portable file format for moving data between platforms. As data is read into the program, it is converted to an internal

Our Contributors: DAVID ABELS heads a consulting practice specializing in business research, public relations, advertising, and marketing consulting. GRANT BLANK is an independent consultant specializing in statistical analysis and database management. He edited a special issue of *Computers and the Social Sciences,* which was devoted to reviewing full-featured statistical software. SHERYL CANTER is a former associate editor of and frequent contributor to *PC Magazine.* RICHARD GOLDSTEIN, Ph.D., is a statistical consultant with Qualitas Inc. He edits the software-review section of *The American Statistician.* LORI GRUNIN is a former associate editor of and frequent contributor to *PC Magazine.* JOSEPH HILBE, Ph.D., is vice president of research and director of biostatistics at the Health Finances Institute in Pennsylvannia, and an adjunct professor of sociology. CHARLES KADUSHIN is a professor of sociology and psychology and an expert on social networks, methods, and survey research; he is currently involved in organization studies. DAVID RINDSKOPF, Ph.D., is a professor of educational psychology and psychology who researches and teaches applied statistics. TED STEVENSON was the associate editor in charge of this story, and BEN GOTTESMAN was the project leader.

file format (a *system file*) for processing. Along with the data itself, system files contain descriptive information such as when and how the data set was created, variable labels, and value labels. System files can be read in much more quickly than text files since they don't have to be converted for processing, and they save you from having to respecify the record layout and data descriptions.

Another issue in a cross-platform environment is the ability to read data from many sources. It wasn't long ago that most statistics packages could read only fixed and delimited text files. Today, statistics packages can import data in almost any form: hierarchical data, grouped data, SQL (structured query language) databases, .DBF files, spreadsheet formats, and more. This can be a huge time saver for businesspeople who must extract data from many sources for analysis.

PC GRAPHICS POWER

Not surprisingly, the packages in this roundup with the best graphics capabilities—the Systat and Statgraphics packages—were written specifically for the PC. The visual representation of data is an important part of data analysis. A scatterplot or line graph lets you instantly detect anomalies, patterns, and trends. The best packages let you interact with a chart as part of the analytic process itself.

Regression analysis, used to guess about information you don't have on the basis of information you do have, is a good example of a widely used statistical procedure in which charting plays an integral role. For example, you might use household income and number of dependents to predict whether or not a potential customer will be a good credit risk. You could do this by identifying a representative group of people and collecting some information about them: income, number of dependents, and whether or not they promptly pay their bills. A scatterplot of the data might suggest that people with higher incomes are better about paying their bills; to quantify how much better, you'll need to run a regression.

But let's say that one person in your study doesn't fit the mold; he makes $100,000 a year, has no dependents, but is rather casual about paying his bills. In

PC MAGAZINE ▶ EDITORS' CHOICE

- **SPSS for Windows**
- **Systat for Windows**

Statistics is a many-faceted discipline: Analysis of survey data, analysis of designed experiments, and econometric and related modeling techniques are all major branches of the statistics tree, each with a profusion of subbranches. Social scientists, marketers, biological scientists, medical researchers, economists, financial planners, and agricultural researchers, among others, all employ statistical analysis in their work, and the needs of each group are different.

Picking one statistical software package to meet the needs of such a diverse collection of professionals is a tall order. However, our consensus is that the needs of a very broad spectrum of statistics consumers will be well-covered by our *two* Editors' Choices: SPSS for Windows and Systat for Windows. While these two packages are not fully comparable, their strengths complement each other. Both of these Windows products are particularly easy to learn and use, compared with the general run of statistics packages.

By virtue of its impressive breadth, SPSS stands as the tool for hard-core statisticians performing heavy-duty number-crunching on powerful systems: There is practically nothing it can't do. And to cover the exceptions, it offers the Matrix language, in which users can write extensions.

SPSS' greatest strength is in analysis of categorical data. It offers strong regression procedures. Support for designed experiments and econometric modeling is less extensive. The menu-and-dialog-box-based interface and powerful, spreadsheet-like data editor serve to flatten the learning curve dramatically. The data-format compatibility is second to none.

Systat for Windows offers an admirable balance of power and ease of use. It's probably the perfect statistical tool for more casual users: those who may own a 386/33 with a 200MB hard disk and really want to understand how to run a T-test that will show them the way (and means).

Systat's statistical algorithms, in many cases the products of well-known statistical professionals, are exceptionally efficient and accurate. Systat's linear models procedure is arguably the best software for analysis of designed experiments offered by any package. (By the same token, Systat is not the package of choice for handling survey and marketing data—or analysis of large data sets generally.) Also impressive is the package's graphical prowess. Both in extent and in quality, Systat's graphing abilities provide a powerful supplement to its statistical procedures.

Systat is perhaps less demanding of hardware resources (memory, disk space, and processor power) than any other product in the roundup. (SPSS, by contrast, is one of the more hardware-intensive.) The result is a particularly effective blend of features, usability, and performance.

Statgraphics Plus, from Manugistics, is close on the heels of our two Editors' Choices. It's a fully menu-driven package with strong, interactive graphics capabilities, but a bit too burdened with limitations (such as file handling—one record per case, lack of standard statistics procedures such as MANOVA and logistic regression, and the lack of a command option) to share the dais. Even so, we mention it honorably as a product that will work well for many users.

the scatterplot, the point representing this person—an *outlier* in statistical terminology—would be far from the other data points. Is he an eccentric, or was there a data-entry error? You'd get more accurate results if you didn't include him in your analysis. But how do you go about identifying the data point and eliminating it? The traditional way is to write program code to identify the outlier, eliminate it from the active data set, and run your analysis again. With interactive graphics, you can do it visually.

FEATURES PLUS

Learn more about PC statistical software from a discussion in ZiffNet's Executive's Online forum, April 26-30, hosted by Sheryl Canter and featuring representatives for the software packages reviewed here. To participate, type GO ZNT:EXEC from any CompuServe prompt.

USER-FRIENDLY STATISTICS?

Today's statistics packages are generally menu driven, or at least this is an option. Sometimes only a portion of the feature set is available through menus, and to access advanced features you must type out the commands. The best packages, such as the Systat and SPSS products, log the command equivalents of the menu options you choose so that you can quickly run the procedures again. Others, such as the Statgraphics packages, rely completely on menus and have no facility for submitting commands. This is a serious disadvantage if you need to rerun the same set of procedures with minor variations or adjustments. Rather than bringing up a command log and selecting the Run option, you are forced to snake through what may be a long series of menus and dialog boxes each time you make a change.

Another variant that is particularly appealing to those who started off in the mainframe world is the ability to run in batch mode rather than in interactive mode. In batch mode, you prepare a command file using a text editor and then submit it to the statistics engine without ever launching the program. The Systat and SPSS packages provide this option.

Many packages now include spreadsheet-like data editors, which were once uncommon extras. Here, these include the Statistica, P-Stat, and Statgraphics packages. Data editors let you sort, recode, and perform other data-management tasks without writing commands. As with menu-driven procedure selection, some packages will write the command equivalents of the data-management tasks you perform to a command log for easy reexecution.

WINDOWS-BOUND

Statistics packages are moving to Windows. SPSS and Systat recently released Windows versions of their packages; StatSoft is working on a Windows version of Statistica, and SAS for Windows is in beta at the time of this writing. The new Windows packages boast superior graphics and are among the easiest to use of all the packages we looked at.

With Systat for Windows, you can view data and graphics simultaneously and make direct, WYSIWYG annotations on a chart. SPSS for Windows has a comprehensive menu system, and its built-in graphics module can produce high-resolution 3-D charts, which can be rotated in virtual space. Another welcome feature in the Windows packages is extensive use of the Windows help system, which lets them easily offer context-sensitive help on statistical procedures and program usage.

Statistics packages are expensive, tending to range from several hundred dollars into the thousands. Most vendors, though, offer substantial discounts to academic institutions. Most of the packages here are sold as base systems with optional modules that you can purchase as needed.

There can be a hidden additional cost: the high-end hardware needed to run these packages. SPSS for Windows requires a minimum of 4MB of memory but runs best with much more. And with its extensive on-line help, the package can take over a sizable chunk of your hard disk. Other products make do with a minimum of hardware by stripping out all but the essential features and using efficient computational methods.

Carefully weigh features, hardware requirements, and prices of these products in order to make an informed choice.

SUITABILITY TO TASK

BMDP/386 Dynamic

Data management	●	●	●	○
Basic statistics	●	●	○	○
Advanced statistics	●	●	●	○

BMDP Statistical Software Inc.

BMDP/386 Dynamic

BY RICHARD GOLDSTEIN

BMDP/386 Dynamic is the current top-of-the-line offering from BMDP Statistical Software. The entire suite consists of 43 statistical programs and three program utilities (Plot, Data Manager, and Data Entry). The cost for 386 Dynamic is $2,695 ($995 for academics), and the cost for the standard version (PC-90) is $2,195 ($495 for academics). If you want, you can start with a smaller subset of 386 Dynamic, priced at $995, and add programs at prices ranging from $75 to $150. Considering BMDP products' high quality and accuracy, these prices are not unreasonable. And they may be especially attractive for those who require the broad range of statistical techniques, numerous options, and strong data-management abilities that BMDP products provide.

Unfortunately, BMDP has made only marginal progress in making its software easier to use or in alleviating its products' traditionally weak graphics. The forthcoming release, which should be on the shelves by the time this review appears, should change some of that. We were given a sneak peak at beta documentation for the next release, and it looked promising. Among the new version's expected features are a new, intelligent, interactive, menu-driven interface called Mentor. The new release promises high-resolution graphics, and users will be able to produce a graph without first running a statistical procedure. Also, some of the graphs should be publication quality, and results will be exportable to graphics and word-processing software. But there will still be no three-dimensional graphing, no brushing, and no spinning or rotating. Also, users won't have the ability to

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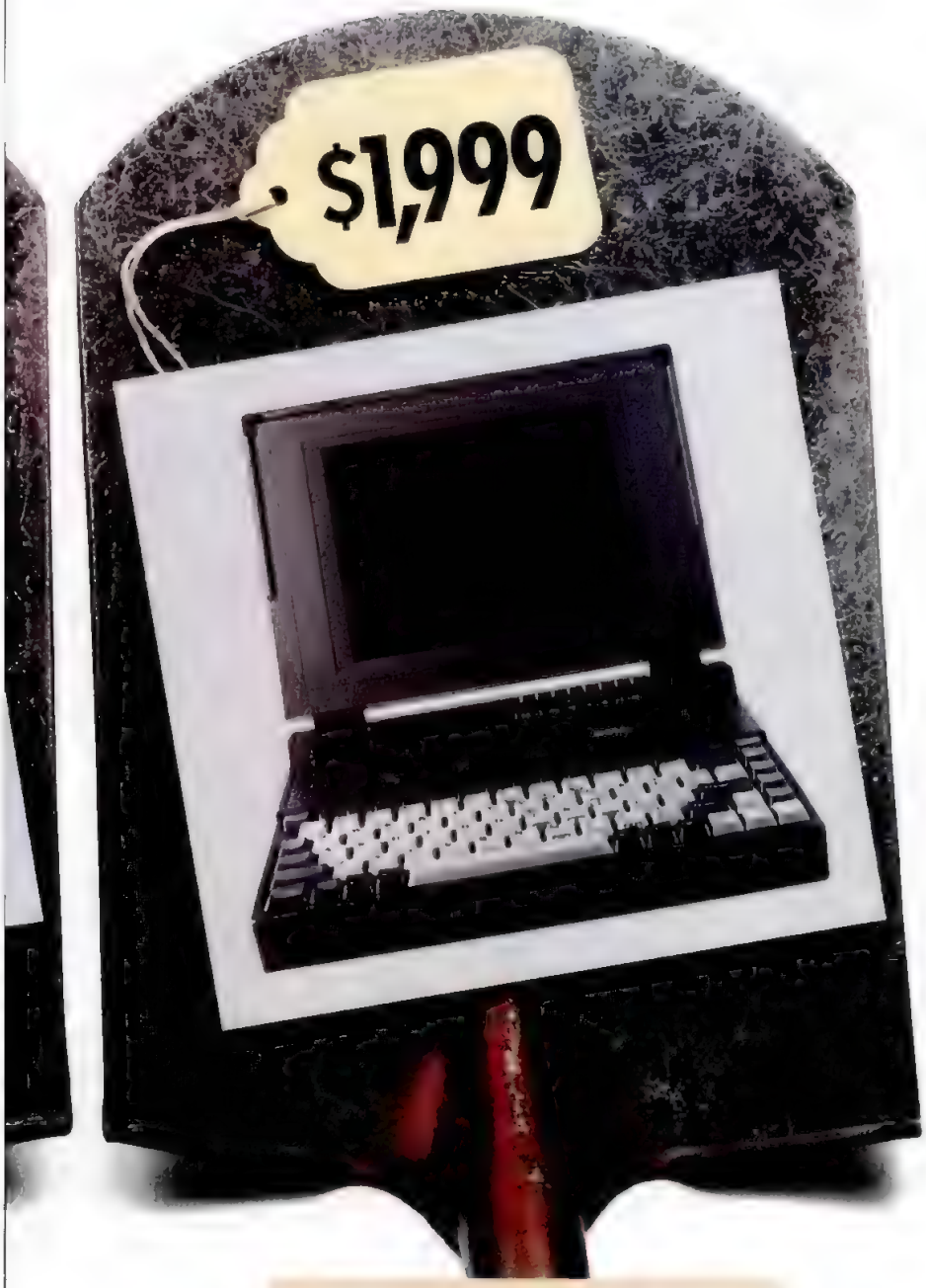

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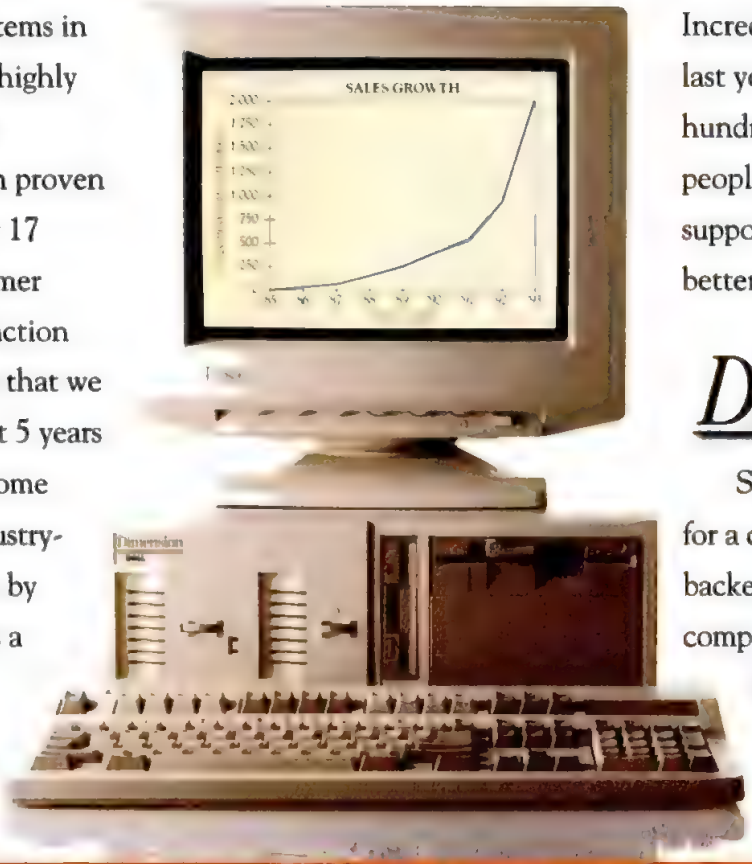

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Source: Reliability Ratings™ - 1992 PC Vendor Survey*

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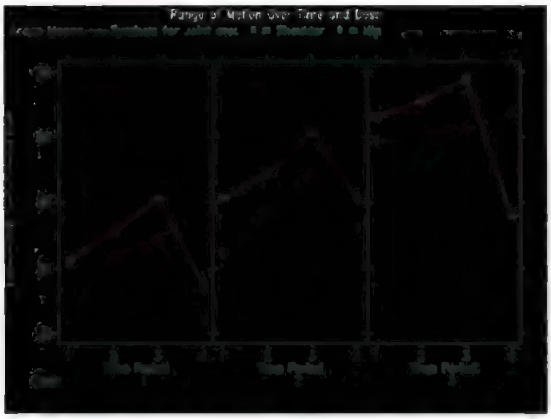


This interaction plot shows why a simple interpretation of each factor by itself will not be useful.

weight the graph symbols based on a variable in the data set.

LEARNING THE LIMITS

We found that 386 Dynamic's ease of use is somewhat improved over that of earlier versions. The package features optional but limited menus, a built-in editor, and extensive example instructions both on disk and in the manual. Start with one of the on-disk instruction sets and modify it for your own use; this is often easiest. Unfortunately, you can only use one procedure at a time. This is surprising, since one important use of the product is moving your data and the output from one procedure to another.

BMDP software remains superb in statistical ability, evidenced in both new procedures and revamped old ones. The latter keep the program current with advances in nongraphical statistical techniques. In addition, the Data Manager provides a powerful data-manipulation facility that easily handled the requirements of our testing, as well as many more complicated tasks. We found that 386 Dynamic is especially strong when handling missing data. It can describe patterns of missing data in your data set and let you input values through several easy-to-use techniques.

The number and size of cases or variables 386 Dynamic can handle is limited only by the capacities of your hardware (up to 16MB of RAM can be used). While it is not extendible beyond that 16MB limit, the strong data-manipulation and file-manipulation capabilities offer extensive options for recasting your data in many ways, including across multiple files. These capabilities range from simple "recodes" to conditional transformations and lagged or leaded variables. File manipulations include the ability to work on nonrectangular files—a rare but sometimes important capability.

A PERFORMER

We found that 386 Dynamic easily handled most of the nongraphical portions of the three assigned tasks that were a part of our testing procedure. The package did have problems with one relatively specialized task, reliability statistics, as well as with some of the graphical tasks. But with a little work, even this output can be massaged into relevant and useful information—even if it's not exactly what you desired. Unfortunately, you're given very little ability to format the output. To do so, the resulting ASCII file must be imported into the data editor or a word processor.

The documentation and technical support are excellent. The documentation explains each procedure, and the appendices contain algorithm information for truly detailed explanations. Also, each program's documentation contains several detailed examples of the required input and output. Furthermore, every part of the output in each example is separately explained in paragraphs cross-referenced with numbers in the manual's example output.

Overall, 386 Dynamic could be easier to use, and it is missing high-level graphics and a programming language so that users can make additions to the package. But BMDP products are aimed at sophisticated data analysts, and for those users, 386 Dynamic provides lots of high-end, high-quality, statistical procedures.

FACT FILE

BMDP/386 Dynamic

BMDP Statistical Software Inc., 1440 Sepulveda Blvd., Suite 316, Los Angeles, CA 90025; 800-238-2637, 310-479-7799; fax, 310-312-0161

List price: $2,695, $995 for academia.

Requires: 2,432K extended memory (maximum of 16MB), 17MB of hard disk space, DOS 3.0 or later, 80386 machine

In short: BMDP/386 Dynamic is aimed at the high-level user of statistics and offers many high-level, accurate, high-quality procedures. Programmability is good but fairly limited. Data-management capabilities are excellent. This should be an attractive product for those who require a broad range of statistical techniques

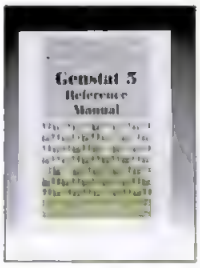
464 ON READER SERVICE CARD

NAG Inc.

Genstat

BY JOSEPH HILBE

The $595 Genstat, Version 5.2, from NAG (Numerical Algorithms Group) is notable mainly for its ability to analyze designed experiments—statistical procedures that test certain types of results. In fact, it is the only offering we looked at for this roundup that supports Generally Balanced Designs, initiated by John Nelder.



A very popular European program, Genstat is aimed primarily at providing a wide range of statistical and data-management capabilities. The package accomplishes this job well, with one major stumbling block: It requires installation of a FORTRAN-based DOS extender in order to run.

According to Genstat's documentation, this extender, called DBOS, is incompatible with Microsoft Corp.'s SmartDrive, Quarterdeck Office Systems' QEMM386, and Qualitas's 386MAX. An attempt to run DBOS with any other loaded memory manager or extender may, according to NAG, re-

SUITABILITY TO TASK

Genstat, Version 5.2

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	●	○
Basic statistics	●	●	○	○
Advanced statistics	●	●	●	○

A New Age Dawns for SAS

A Popular Stat Package Has a Fresh Identity

by Joseph Hilbe

The SAS Institute has for some time been positioning SAS—historically the most widely used statistics package on the market—as an enterprise-scale information management system that happens to include a vast array of statistics-related tools.

Although the newest PC-based SAS product, Version 6.08 for Windows, was a projected three months from final release at press time, we previewed a beta copy provided by the Institute. What we saw impressed us.

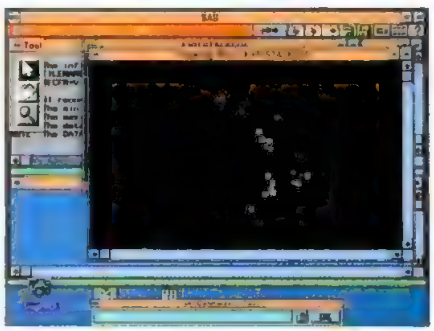
THE SAS SIGNATURE

SAS began life as a mainframe program and was later ported to smaller computers only with some difficulty. The program's architecture is resource-intensive, with extensive disk-space and memory requirements. Personal computers have only just become powerful enough to run SAS effectively.

For example, the 8MB of RAM recommended for midrange use of SAS is probably fairly typical of serious Microsoft Windows applications today, but this amount should probably be taken as a minimum. In total, the components of SAS we looked at occupied nearly 110MB of disk space. True, the modular format of SAS allows a user to license only those features of the complete system required for his or her own work (SAS is licensed for a year at a time, not purchased outright), but a minimal statistical configuration would claim close to 40MB.

TECHNICAL ROOTS

SAS, really a programming language, has traditionally used a command-line interface, and this convention is retained in SAS/Stat, the module that handles most of the mainline statistical procedures, even under Windows. But SAS for Windows also contains totally new modules, such as SAS/Insight, that incorporate procedures or methods of analysis not found in earlier versions, built around an entirely new menu-based, point-and-click graphical interface that departs radically from SAS's traditional way of doing things. While the mixture of the old and the new means that users have to learn two interfaces rather than just one, all modules can take advantage of the Windows clipboard and device drivers and also easily access other SAS modules.



SAS/Insight's graphical output shows a 3D-plot that can be rotated to gain added insight.

OLD MEETS NEW

Insight, a powerful new GUI-style module, is an exploratory data analysis (EDA) tool combined with a comprehensive generalized linear modeling program. Researchers are given the ability to examine data in up to three dimensions using EDA features such as brushing, highlighting, 3-D rotation of plots, and observation coloring and labeling.

Users can also compare empirical response distributions with Gaussian, lognormal, exponential, Weibull, or kernel distributions with user-selected threshold, scale, and shape parameters. They can layer distribution curves upon one another or compare summary statistics to select the closest fit. In addition, the product provides both parametric and nonparametric scatterplot curve fitting as well as correlation analysis with confidence ellipses.

SAS has long offered a general linear model (GLM) module that deals primarily with Gaussian-based statistical procedures. The SAS/Insight module applies a more contemporary meaning—generalized linear models—to the acronym GLM. Insight's GLM enables the user to model Gaussian, binomial, Poisson, gamma, and inverse Gaussian distributions with all of the standard link functions.

In addition, there are a host of modeling options from which to choose. Residual diagnostics may be graphed using Insight's facilities or they may be directly imported into SAS/Graph for publication-quality presentation. A new GLMMOD program is currently under development for the SAS/Stat module that will provide even more enhancements for GLM modeling.

BUILD TO SUIT

SAS offers a variety of other types of modules to meet a broad spectrum of user requirements. SAS developers have clearly expended a great deal of effort to integrate the overall system so that those using multiple modules need spend little time switching tasks. We were quite pleased by the ease with which we were able to access one SAS module from another. The optional SAS/Assist module supplements the basic program integration by serving as a master control for most of the data management and statistical procedures that are offered by SAS.

Also worthy of note is SAS's documentation, both hard copy and on-line. The many volumes that accompany the statistics-related modules serve not only as guides to using the product, but serve as statistics texts as well. In them, users will find many formulas and algorithms

that are otherwise unavailable except in obscure texts and journals.

HIGH-TICKET ITEM

For all its strengths, SAS is not without drawbacks. For individual users especially, cost is likely to be a major issue. The first-year license fee for the Base system (a required resource for all other SAS modules) is $895. Each additional module, such as Insight, costs another $695 for the first year. Each subsequent year, Base costs $395, and the additional modules cost $300 each. To be sure, these prices include technical support (which is much improved from the old days) and also incremental upgrades. There are special academic rates as well as discounts on the licensing of more than four modules. But any way you slice it, SAS is expensive.

Then there's the hardware problem: The Base module alone takes up a minimum of 24MB. Stat, the general purpose statistical module, takes 11.7MB; Insight takes an additional 2.5MB; Lab, an excellent tool for basic data management and Gaussian regressions, takes 4.8MB; ETS for forecasting takes 7.4MB; QC for quality control takes 11.8MB. The outstanding Graph module adds a whopping 17MB. As mentioned, 8MB of RAM is a practical minimum.

Lastly, the point-and-click Windows-ness of the newer modules may not be perceived as a benefit by those who are accustomed to the total flexibility of the old interface. In the menu-driven Insight module, for example, we could not make simple changes to algorithms or output using the SAS language. Nor would Insight let us compile a log of commands or output results—a serious omission.

The new SAS for Windows, vast and powerful as it is, will not suit everyone. But for those who have the hardware, the funds, and the need to perform other data management tasks in addition to sophisticated statistical analysis, SAS may represent *la crème de la crème.* □

This represents partial Genstat output for the modeling of a log-gamma regression.

sult in hard disk corruption and loss of data. Moreover, even after disabling other memory managers or extenders, more specific environmental values must be placed in the CONFIG.SYS to assure that the program will run properly. To run Genstat, we had to maintain two sets of AUTOEXEC.BAT and CONFIG.SYS files. Another item that should be mentioned is that technical support is largely provided via e-mail or fax from England. At this time, U.S. support is extremely limited.

Central to Genstat are General Linear Models (GLMs)—a variety of extensions to the type of linear regression taught in introductory statistics classes. Some eight statistics packages now incorporate GLMs into their table of offerings; many are now making them something of a centerpiece. This is not without justification. Normal linear regression assumes, among other things, that the response or dependent variable comes from a normal or Gaussian distribution. Moreover, many continuous responses are not normally distributed. In these cases, it would be a statistical mistake to model data by standard linear regression methods; we find this being done frequently, however.

A GOOD PERFORMER

In addition to performing well in the specialized area of experimental design, the package is an extremely powerful general-purpose statistical package. It features color windows, menuing, and an array of statistical procedures. Included in its offerings and abilities are GLMs; extensive descriptive statistics; tables; multivariate analysis, including factor and principal components analysis; multidimensional scaling; cluster and discriminant analysis; comprehensive time series modeling; and three-dimensional graphics. Genstat also provides for extensive in-house data management.

Users are given a choice of using either a command line or a menu system. The latter is presented as a series of questions, the answers to which determine subsequent selection choices. Not all modeling situations can be accommodated with menus, but the user is always able to switch back to command mode easily. Genstat also provides matrix algebra and a programming language.

Anyone who engages in experimental designs would be wise to give Genstat a hard and serious look. It comes with a reference manual exceeding 700 pages, as well as a very useful reference summary notebook. Users who are willing to work in the DBOS environment will find Genstat a most excellent statistical package.

FACT FILE

Genstat, Version 5.2
NAG Inc., 1400 Opus Pl., # 200, Downers Grove, IL 60515-5702; 708-971-2337; fax, 708-971-2706

List price: $595
Requires: 2MB RAM, 8.5MB hard disk space, DBOS DOS extender (included with the package); math coprocessor recommended
In short: Genstat is a general, all-purpose statistical package that can be used to model a wide variety of statistical problems. It features both a menu and a command-line mode. The menu mode guides users through basic statistical procedures. The product also features excellent documentation and an extensive programming capability. Unfortunately, Genstat also requires the installation of a FORTRAN-based DOS extender in order to run.
465 ON READER SERVICE CARD

Minitab Inc.

Minitab

BY DAVID ABELS

The $995 Minitab, Release 8 Extended ($595 for academia), can't compete with powerhouse products such as the SPSS packages, but then it was never meant to. This well-supported, user-friendly statistical product from Minitab certainly has its limitations as a general-purpose statistics package, lacking multivariate, test reliability, item, and correlation analyses. Still, Minitab has versions on a variety of platforms and systems and is supported in a host of statistics text books and university curriculums. Moreover, it excels in quality-control procedures.

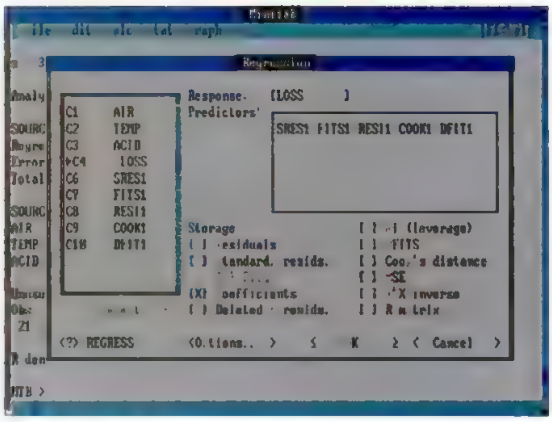
MINI BUT FRIENDLY

Despite its lack of depth, working with the program is enjoyable, thanks to Minitab's drop-down menu system. Minitab also boasts a fairly robust system capacity for a product with such a modest features list. Given sufficient RAM, it is capable of supporting up to 1,000 variables and approximately 3.1 million observations.

Minitab also boasts a fairly elaborate macro language and is buttressed by a library of prewritten macros that are available free of charge from the company.

The bulk of these macro libraries focuses on quality-control procedures either developed or refined by the company and its wide and active network of user support groups.

As mentioned, Minitab excels in quality-control procedures. Among the features and macros geared toward this process are easy-to-use charts of moving averages and weighted moving averages, Poisson charts, Pareto charting, process capability macros, and response surface analysis.



This screen, for regression computation, shows a typical dialog box for a drop-down menu choice selected in Minitab.

SMOOTH CURVE

Minitab's major assets are its ease of use and small learning curve, although other statistical products, such as SPSS for Windows, have recently caught up in this area. Basic statistical analyses with Minitab require little more than a few mouse clicks and a bit of familiarity with the program. And macro programming should be easy for users with prior knowledge of virtually any kind of programming or spreadsheet macro language.

Minitab is built around a limited data-entry spreadsheet that has no arithmetic functions. And even though the amount of keys it can sort is limited only by the size of the spreadsheet, it does not support matching by key.

Basic data handling and transformations are relatively easy, though data cleaning is difficult, and the program does not provide for easy conditional-based operations.

OTHER POINTS

One especially helpful Minitab feature is that it offers the option of using the by-variable, which helps reduce the amount of physical subsetting necessary for statistical procedures. Users will find that this feature can come in particularly handy for social science, education, market, and opinion research.

Perhaps one of Minitab's most valuable features is its scrollable session stream. All commands, macro executions, error messages, and report output are logged into the stream. Users can scroll up and down through this report and cut and paste individual command lines to their current session. The text cannot be altered within the report stream, however, unless it has been exported to a word processor or a graphics or page-layout program. Graphics can also be printed to a file in printer-specific formats or in HPGL or PostScript. Minitab's high-resolution graphics are quite attractive, easy to read, and can even accept some annotation.

Next to to Lotus 1-2-3 or Symphony, Minitab holds its own as a tool that can cover the needs of many midlevel users. With its low barrier to entry, point-and-click menu system, and strong quality assurance procedures, the package overcomes many of its limitations for general statistical procedures. Minitab is notably easy to learn; offers users a good, basic feature set; and surely has a place in the market. For those who think they may not be able to afford the commitment that is necessary with some of the more full-featured packages, this product may be the one to pick up the tab.

SUITABILITY TO TASK

Minitab, Release 8 Extended

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	●	○
Basic statistics	●	●	●	○
Advanced statistics	●	●	○	○

FACT FILE

Minitab, Release 8 Extended
Minitab Inc.,
3081 Enterprise Dr.,
State College, PA 16801-3008;
800-448-3555, 814-238-3280;
fax, 814-238-4383

List price: $995, $595 for academia.
Requires: 4MB RAM, 5.9MB hard disk space, DOS 3.3 or later.
In short: Minitab has some general statistical procedure limits but works well as a user-friendly menu-driven program geared to academic use, basic statistical analyses, and quality control. It features spreadsheet data entry, excellent session streaming, and good macroing abilities. Minitab's high-resolution graphics are attractive and easy to read. This is an excellent, reliable package with an intuitive style conducive to quick learning.

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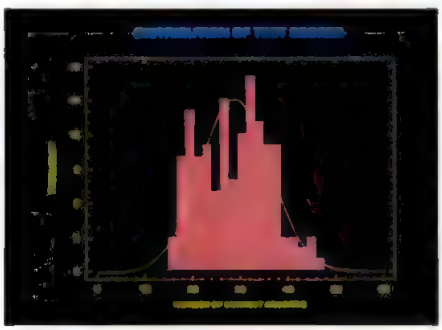

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Home Office Computing 1/93

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The Independent Comparative Ratings Report for Selecting IBM PC Business Software

Vol.9, #6, September 1992

Advanced Word Processors for Windows	
	Overall Evaluation
1ST Ami Pro 3.0 for Windows	**8.7**
2ND Word for Windows 2.0	8.1
3RD WordPerfect 5.1 for Windows	6.1

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PC/Computing 12/92

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Windows Magazine 2/93

"Ami Pro Version 3.0... is the most graphical, colorful and in many ways the most powerful word processor on the market... no other package can match its ambition, its range of functions or the sheer pleasure of using it."

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Forbes 2/93

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CIRCLE 143 ON READER SERVICE CARD

NCSS

NCSS

BY DAVID ABELS

Priced at $395, the complete package of NCSS, Version 5.03, ranks as the most affordable offering we looked at for this review. NCSS (Number Cruncher Statistical System) covers a lot of ground that its more expensive competitors often leave untraveled.

Although NCSS covers most basic statistical functions, modules that cover more esoteric and advanced features (such as time series analysis) can be purchased separately or (at a substantial discount) with the base package. NCSS has no mouse support, but a keyboard macro system, hotkeys, panel defaults, and the ability to save and retrieve panels give users additional menu input control that makes the system easy to use.

SUITABILITY TO TASK

NCSS, Version 5.03, Complete

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	○	○
Basic statistics	●	●	●	○
Advanced statistics	●	●	●	○

VIRTUE OF SIMPLICITY

The real beauty of the NCSS package is in its simplicity. The program, which features a spreadsheet-type data-entry format and panels for each menu selection, eases the burden of having to learn a programming language and replaces it with fill-in-the-blanks.

Some users may view the absence of a programming language as too radical a departure from traditional heavy-duty statistical packages. Each NCSS menu selection is essentially a programming language routine, however, with the various options in each panel proving generally comprehensive for a variety of situations and analyses. Instead of asking users to write looping and branching statements or requiring them to execute macros in a language or scripting environment, NCSS attempts—and largely succeeds—at providing in its menus and panels most of what users might need.

BASKET OF GOODIES

The main menu and submenus yield an extensive array of statistical functions, routines, and outputs, including interesting geography-type survey mappings and fabulous three-dimensional graphics that can be rotated. NCSS also provides a variety of screen, printer, and plotter drivers from which users can generate color-print graphics and high-resolution graphics on-screen. In addition to this valuable graphics output, NCSS generates an amazing variety of advanced statistical functions and routines.

NOT ALL BELLS AND WHISTLES

The program does have its limitations, however, both in the size of its spreadsheet (maximum of 500 variables) and in its data-cleaning and massaging abilities. In the latter area, NCSS displayed some problems importing files, and it didn't work very well with alphanumeric input.

A major NCSS weakness is its help and error-handling facilities. Though the documentation and panel defaults provide general guidance for most chores and panel entries, certain panel-entry combinations result in confusing error messages. And though generally intuitive to use, NCSS's data-entry method can occasionally be cumbersome, since it forces users to go through all the data-entry fields whether they need to or not.

ROOM FOR IMPROVEMENT

NCSS could improve upon the way it stores statistical output. Some statistics, such as regression coefficients, cannot be output directly to an NCSS data file. This severely hindered running one of a series of regression techniques in our test script. While NCSS permitted many regression diagnostic measures to be output to variables during this scenario, the program could not output actual regression coefficients directly to the related data file. In many places, the program could also make use of a by-variable function to speed processing of records that have to be subsetted.

Preparing presentation-quality reports in NCSS can be difficult and, as with data cleaning, is better done on a word processor or in a spreadsheet package. Furthermore, although the quality of NCSS's graphics presentation is quite good, the package cannot export graphical images in standard PCX, TIFF, or related graphics file formats.

Still, NCSS is highly recommendable to statistics users at a variety of levels; it's appropriate for statistics educators and stu-

FACT FILE

NCSS, Version 5.03, Complete
NCSS, 329 N. 1000 East, Kaysville, UT 84037; 801-546-0445; fax, 801-546-3907

List price: $125 for base system, $395 complete.
Requires: 640K RAM, 2MB hard disk space for base system, 6MB hard disk space for complete system, DOS 3.0 or later.
In short: An easy-to-use menu-driven package with extensive graphical and statistical capabilities, NCSS features a data-entry spreadsheet and preset customizable "panels," which configure each menu selection. Limited in its data-cleaning abilities and flexibility, NCSS still largely succeeds at providing users with almost every function necessary to perform a large spectrum of statistical analyses. This excellent package shines as a comprehensive and easy-to-use statistics package.

467 ON READER SERVICE CARD

This screen shows NCSS's Item Analysis panel from its Advanced Statistics section.

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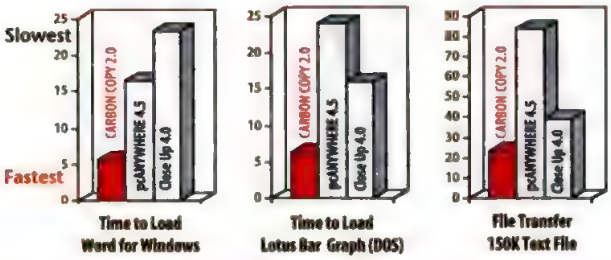

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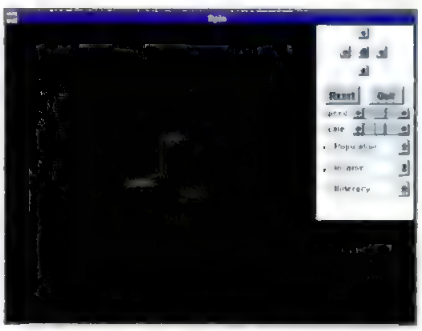
CIRCLE 107 ON READER SERVICE CARD

StatSci Heeds Windows Call

S-Plus Makes the GUI Environment its Own

by Richard Goldstein

Statistics vendors have heard the cry of academicians and other mere mortals for Windows statistics packages. StatSci, for one, is prepared to heed the call. The company has taken the GUI environment to its heart, created S-Plus 3.1 for Windows, and decided to cease upgrading the DOS version of S-Plus. It will, however, continue to sell and support the DOS version for the next year. The new S-Plus for Windows was shipped too late too be included with our other full reviews, but we did take a look at a beta version of the program.



This frozen version of a spinning graph shows how freezing in different places can aid analysis.

S-Plus for DOS has always been aimed at advanced statistical researchers and users who want specialized capabilities. The new Windows version ($1,195) includes all the features and functionality of the DOS application, but it also addresses ease-of-use issues and allows users to have statistical and graphical output displayed simultaneously.

At its heart, S-Plus is an object-oriented programming language with a number of built-in statistical procedures that allow users to explore their data and try new techniques, especially if they are willing to program these techniques themselves.

PROGRAMMABILITY

S-Plus' programmability includes extensive data-manipulation capabilities. Much of the product's data manipulation is accomplished via user programming rather than built-in functions. One exception is the built-in ability to use virtually any part of the output of an analysis in subsequent analyses: Users can save the results as part of a data set and subsequently merge them with other data sets already on disk.

The selection of statistical procedures is strongly oriented toward statistical models such as regression, of which S-Plus offers a great number. However, many of the routines provide the building blocks necessary to construct fancier procedures. The provided tools are so flexible that users can add virtually anything they can think of, including statistical procedures that they invent. As a result, S-Plus for Windows is more of a broad programming language that relies on users to add the depth.

Many of the built-in routines will not automatically do what the user wants them to do. Users may have to supplement the base routine with their own functions. Also, the selection of statistical techniques are those included in the standard statistical literature: If your background is in econometrics or some other social science, you may not find many of the tools you are familiar with.

CODE IT

S-Plus is a true programming language, but it is quite different from other statistical languages. For example, while some explicit looping commands are present (FOR, WHILE, REPEAT), much of the documentation seems to emphasize implicit looping and new commands such as APPLY.

In addition to using S-Plus' native language, users will also be able to write procedures in either FORTRAN or C and then incorporate them into S-Plus.

SUPERIOR GRAPHICS

The graphics in the S-Plus for Windows beta we saw were impressive. Exploratory graphics such as histograms and boxplots, flexible 2-D analytic plots, and three varieties of 3-D plots (contour, perspective, and image) will be offered. S-Plus for Windows will also feature the ability to have a scatterplot matrix and a rotating 3-D plot with brushing in the same window.

The interface looked consistent with other aspects of the package's design, offering an almost daunting amount of flexibility. Some users may be frustrated by the inability to show and save on-screen output to a file simultaneously.

S-Plus's default output is an example of a generic function. The output provided is specific to the analysis performed; but with minimal programming effort, the user can customize the output. Further, the new output can be modeled after the default and saved either as the new default or as an option without destroying or losing the old output format.

S-Plus 3.1 for Windows looks as if it will be an exciting entrant into the Windows-statistical software arena. But its powerful programming environment could end up being overshadowed by a steep learning curve. □

▶ FACT FILE

S-Plus 3.1 for Windows
StatSci, 1700 Westlake Ave. North, # 500, Seattle, WA 98109; 800-569-0123; 206-283-8802; fax, 206-283-8691
List price: *$1,195.*
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– The New York Time

A Partial List of Features	Managing Your Money 9.0	Quicken 6.0
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Reconciles Accounts Automatically	✓	✓
Creates Profit & Loss Statements, Balance Sheets	✓	✓
Plans Taxes On-Screen w/Form 1040, Schedules A, B, C, D, E, F, SE	✓	
Provides a Comprehensive Library of Standard Reports	Over 60	18
Includes a Complete Collection of Standard Graphs	Over 26	21
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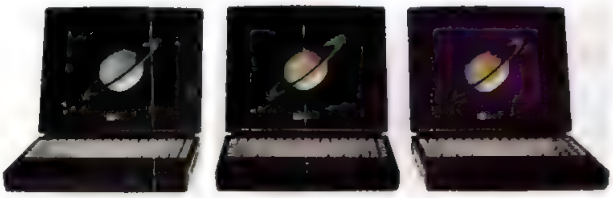

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Memory	2MB	4MB	4MB	4MB	4MB	4MB	4MB
Hard Drive	105MB	105MB	105MB	170MB	170MB	170MB	170MB
1.44MB FDD	●	●	●	●	●	●	●
1.2MB FDD		●	●	●	●	●	●
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dents, managers, analysts, and high-level statisticians and researchers. Its functionality provides a comfortable and safe haven for anyone needing to generate complicated series of statistics quickly. For its affordability, broad statistical coverage, and impressive graphics capabilities, NCSS shines as a comprehensive and easy-to-use statistics package.

P-Stat Inc.

P-Stat

BY DAVID ABELS

While P-Stat has many features and strengths that have earned it fans across a wide variety of platforms and systems, its latest DOS version, 2.15 ($695), has not kept up with the times. P-Stat makes you long for a more simple drop-down menu or point-and-shoot command. We found that its detailed and highly syntactical programming language, menuing system, and commands can be especially cumbersome to use.

Still, P-Stat offers a fairly wide range of statistical functionality that includes a good set of basic and advanced statistics. It handles data cleaning and recoding fairly efficiently and provides excellent data and file management. P-Stat allows you to move data between files and merge files easily, and it automatically keeps a backup version of your current data file. Graphics, however, are somewhat limited, despite support for PostScript.

SUITABILITY TO TASK

P-Stat, Version 2.15

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	○	○
Basic statistics	●	●	○	○
Advanced statistics	●	●	○	○

SPREADLESS DATA ENTRY

Because there is no true or even pseudo spreadsheet-type data-entry interface, P-Stat makes simple functions, such as changing a cell entry, overly complicated. Instead of being able to point your mouse to a cell and edit a number, you are forced to use either a distracting data-entry editor or a series of menu entries or commands.

P-Stat's programming language is a powerful tool, giving you the ability to create extensive macros, loops, and formulas. The FORTRAN-based language, however, may prove difficult to master. On-line help is limited in general, and error messages are not very helpful. An error will automatically open the command-line editor, which is useful for correcting and reexecuting command sequences. You may find, however, that the command editor's own syntax can be daunting as well.

EASY RERUNS

P-Stat does make good use of the editor, however. One powerful feature accepts menu input and translates it into programming commands so that you can edit the sequence and rerun it at will. P-Stat does not generate a combined output of commands and statistical results. Instead, it separates commands and any related statistical output into separate files. You will find that the program does provide the ability to modify reports, annotate graphs, and print and save most statistical results.

Although P-Stat's documentation is generally helpful, it lacks sufficient syntax examples. The documentation often assumes a knowledge of areas you may not be familiar with and offers little place to turn to other than its poorly constructed index.

The program offers a solid array of descriptive statistics, tables, and nonparametric methods. It also covers most linear and nonlinear regression needs, although it does not do Logistic or Probit nonlinear regression. P-Stat does not provide for any repeated measures in its multivariate analyses. Nor does it feature any multidimensional scaling techniques.

P-Stat's lack of high-resolution graphical capabilities is perhaps one of its most notable deficiencies. For the most part, P-Stat is unable to generate publication-quality output.

The program's existing graphics are character based, and the software does nothing in three dimensions. The system is limited in two-dimensional graphing and does not produce bar charts, pie charts, or probability plots.

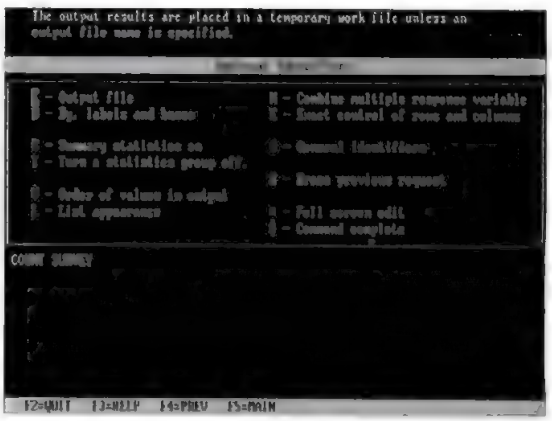
FACT FILE

P-Stat, Version 2.15
P-Stat Inc., 230 Lambertville-Hopewell Rd., Hopewell, NJ 08525-2809; 609-466-9200; fax, 609-466-1688

List price: $695 for basic package, $1,095 including add-ons and one year of maintenance
Requires: 2MB RAM (4MB or more recommended), 6.7MB hard disk space, DOS 2.1 or later, math coprocessor.
In short: This is a competent package with good file management and a fairly deep range of built-in statistical routines and measures. Somewhat difficult to learn, P-Stat requires users to understand its fairly complex programming language even when they are using its menu system. Available on a wide range of platforms, the DOS version has the look and feel of dBASE and has limited graphics and a complicated approach to session edits, outputs, and streams
489 ON READER SERVICE CARD

P-STUCK

Another of P-Stat's weaknesses showed up when we attempted to determine whether or not variable transformations were needed to improve the results of a regression based on data produced from



P-Stat's menus and submenus essentially act as command generators. This submenu screen shows a menu box.

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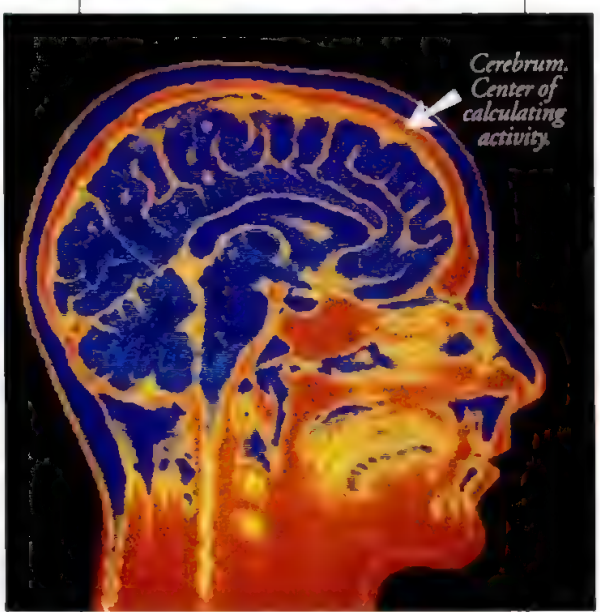

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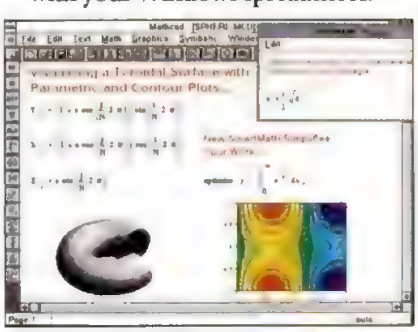

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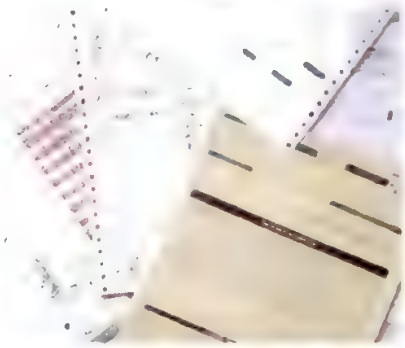

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TEXAS INSTRUMENTS

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a relatively small production run. The package provides no actual methods such as Box-Cox to help you determine whether or not variable transformations should be done on these types of dataset regressions. Instead of relying on a canned procedure, we were forced to construct a macro to produce the analysis.

While P-Stat certainly allows you to massage and manage large groups of records and files with a relative amount of ease, its overall complexity renders us hard-pressed to recommend it as a suitable package for time-constrained users. We would also have trouble suggesting it to users who need a statistics package with especially advanced analyses or graphics. P-Stat is more likely to meet the needs of power users in fields where file and data management are especially important, such as medicine and market research.

SPSS Inc.

SPSS for OS/2
SPSS for Windows
SPSS/PC+

BY SHERYL CANTER AND CHARLES KADUSHIN

If you are looking for a statistics package that can run virtually every procedure ever invented, you'll like SPSS. SPSS (Statistical Package for the Social Sciences) has gone far beyond its original mission. The SPSS philosophy is to support everything, offer everything, and let the user pick and choose. Its power can get inexperienced statisticians into trouble, since it's easy to inadvertently generate hundreds of pages of output, overwrite a master data set, or generate meaningless statistics of all types; SPSS assumes you know what you're doing.

This catholic approach is balanced by a long tradition of outstanding documentation; manuals authored by Marija J. Norusis, who wrote the SPSS manual, have long been sold in bookstores as statistics texts. And the same excellent documentation is available on-line. A built-in glossary explains the proper use of statistical procedures, and context-sensitive help for command syntax is available.

SUITABILITY TO TASK

	POOR	FAIR	GOOD	EXCELLENT
SPSS 4.1 for OS/2				
Data management	●	●	●	●
Basic statistics	●	●	○	○
Advanced statistics	●	●	●	●
SPSS 5.0 for Windows				
Data management	●	●	●	●
Basic statistics	●	●	●	●
Advanced statistics	●	●	●	●
SPSS/PC+, Version 5.0				
Data management	●	●	●	○
Basic statistics	●	●	●	○
Advanced statistics	●	●	●	●

MAINFRAME POWER ON THE PC

A standard for statistical analysis on mainframe and minicomputers since the late 1960s, SPSS was the first statistics package ported to the PC platform and is now available for OS/2, Windows, and DOS. SPSS for Windows, released in June 1992, contains the most up-to-date version of the user interface and the engine. With the exception of the DOS product, all versions of SPSS—from mainframe to mini to micro—share the same command syntax, making for easy portability.

SPSS is sold as a base package with optional modules for "Advanced" and "Professional" statistics to help users economize on dollars and disk space. (In the OS/2 version, the Professional procedures are included in the base package.) Each package costs a relatively expensive $2995.

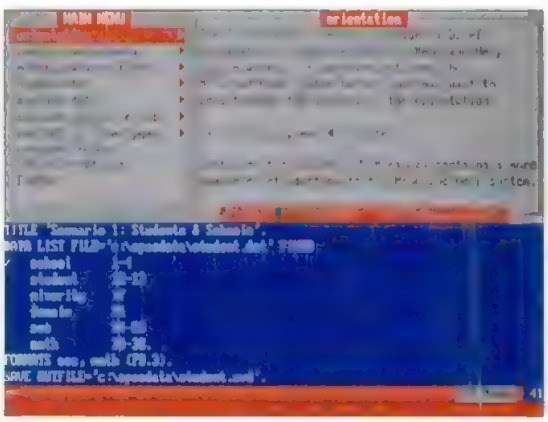
In case you need a procedure that is not provided, the matrix programming facility in the Advanced package lets you write your own statistical routines. (The matrix facility is not available in the DOS version.) Matrix provides functions for performing matrix algebra, an integral part of much statistical computation but probably not something you want to program yourself.

All versions but the DOS version contain a macro facility that lets you automate the repeated execution of a procedure, run several procedures at once, or encapsulate complex input procedures in a single command.

SPSS FOR WINDOWS

For those of us who started off using SPSS on mainframes, typing programs on punch cards, using SPSS for Windows—with its state-of-the-art user interface and rich feature set—is especially satisfying. But you'll need an amply equipped computer to run it, one with plenty of disk space and memory and a fast CPU. Without an adequate platform, the product can be frustratingly unstable as you push at the limits of your system resources. Our test-bed system was a 486 with 8MB of RAM and a 10MB Windows swap file; but even with this setup, we occasionally ran out of resources. SPSS recommends 12MB to 16MB of RAM and a 20MB swap file for optimal performance. With a computer so equipped, the product runs with minimal problems.

Many—but not all—procedures can be run from a set of logically organized pull-down menus; you no longer need to remember command syntax. A series of dialog boxes guides you through the se-



SPSS/PC+ uses a hierarchical menu with keyed help to let you interactively build commands in the "scratch pad" shown at the bottom of the screen.

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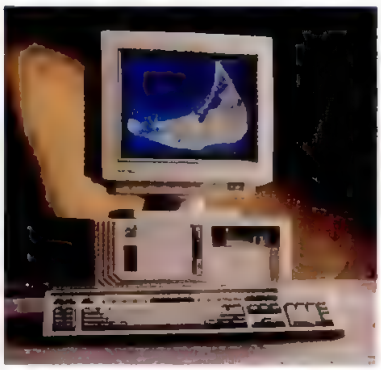

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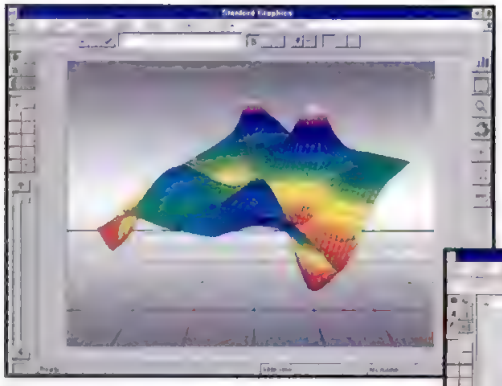

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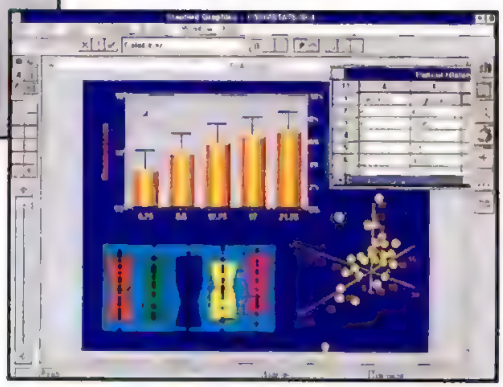

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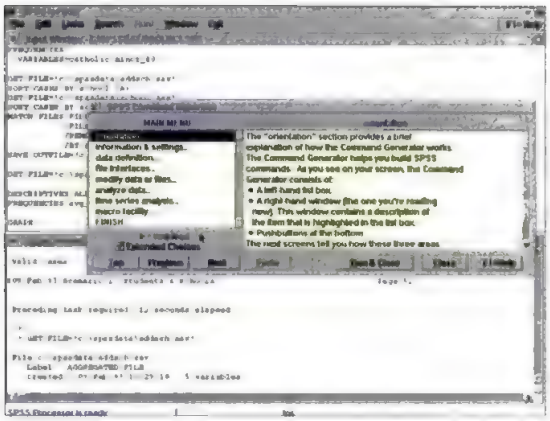

The command generator in SPSS for OS/2 works very much like the command builder in the DOS version. Editing is made easier by the graphical user interface.

lection of options, and then you can choose to either run the procedure or paste the syntax for the procedure into the syntax window for editing or later use. Commands are executed from the syntax window by highlighting them and clicking on the Run button.

LOOK ELSEWHERE

Users should realize that not all procedures are available through the menus. In fact, not all the options for a procedure may be available through the menus. If you don't see it in the menus, check the manual or on-line help; the feature may be available only through direct commands. SPSS reports plans to integrate even more of the product's functionality into the menu structure of the next release.

The SPSS/PC+ interface is like no other package, which is part of the reason it's so difficult to use.

The syntax window has an unusual feature that can be both an advantage and an annoyance: Its editor operates in "box" mode. When you highlight text for execution, you don't have to highlight an entire line. In fact, you can have a second set of commands sitting in the column farthest to the right, and as long as they're not highlighted when you click on Run, they will be ignored. This is the convenient part. The annoying part is pasting code from other parts of the file. Rather than inserting the necessary lines, the editor moves the existing text over to the columns farthest to the right, which may not be at all what you wanted. It would be nice to be able to turn this feature on and off as desired. A built-in report writer lets you design attractive reports, but not easily. The lack of a print-preview option makes report design a frustrating hit-or-miss proposition.

SPSS for Windows is the first version of the product to introduce built-in high-resolution graphics. Graphical output is written to the "Carousel," where you can cycle through the graphs you produced and, if you wish, launch an editor. The editor lets you add regression lines and change labels, but you cannot size with your mouse or make direct annotations on the graph. All editing is menu- or command-driven, and you cannot use the graphs interactively. You cannot, for example, identify and remove outliers as you can with Manugistics' Statgraphics products. We found the graphics Carousel to be one of the most resource-hungry features of the product; you can quickly run out of memory if you run many graphs.

There is also a separate spreadsheet-like editor for handling rectangular data. If you iconize the data editor, the name of the icon changes as your active data set changes. This is a handy device for keeping track of where you are.

SPSS FOR DOS

Released in 1984, the DOS version of SPSS had to run in the 640K of memory available to PCs at the time. To meet this requirement, the designers stripped out many of the data-management features (looping, branching, array support) and altered the standard mainframe command syntax. Unfortunately, the current DOS product, SPSS/PC+, Version 5.0, suffers from this legacy, even though the 640K barrier has been broken. (The package is available in two versions: 640K and extended memory.) The user interface is awkward, and programs written for SPSS/PC+ are not portable to SPSS on other platforms.

The SPSS/PC+ interface is like no other package, which is part of the reason it's so difficult to use. The top part of the screen contains a hierarchical menu on the left, and an explanation box, keyed to the menu, on the right. The bottom half of the screen is the "scratch pad," where SPSS/PC+ commands are entered and run. The menus let you build the syn-

FACT FILE

SPSS 4.1 for OS/2

SPSS 5.0 for Windows ◄ PC EDITORS' CHOICE

SPSS/PC+, Version 5.0

SPSS Inc., 444 N. Michigan Ave., Chicago, IL 60611-3962; 800-543-9262, 312-329-2400; fax, 312-329-3668

List price: $2,995 for all options; academic discounts available

Requires: SPSS for OS/2: OS/2 1.1 or later, 4MB RAM minimum, graphics adapter, 20MB hard disk space; mouse and math coprocessor highly recommended. SPSS 5.0 for Windows: 286-based PC or better (386 strongly recommended), 4MB RAM minimum, Microsoft Windows 3.0 or later, Microsoft Windows-compatible mouse strongly recommended and required for graphics editor; math coprocessor strongly recommended for graphics work; EGA, VGA, or Hercules graphics adapter, 15MB hard disk space for base system, 35MB hard disk space for full system with all options SPSS/PC+, Version 5.0 2MB RAM, 1MB extended memory; 11MB hard disk space for base system (more for options); DOS 3.0 or later graphics require CGA, EGA, VGA, or Hercules graphics adapter.

In short: The three versions of SPSS for the PC platform are all quite different SPSS 4.1 for OS/2 hasn't seen a significant upgrade for three years and doesn't take advantage of the OS/2 2.0 Workplace Shell. SPSS/PC+, Version 5.0 (for DOS), provides a rich selection of procedures but an awkward user interface, and its command syntax differs from that of the mainframe product. But SPSS 5.0 for Windows is head and shoulders above the DOS and OS/2 versions. With its comprehensive feature set, pull-down menus, data editor, and built-in graphics, SPSS 5.0 for Windows is a hands-down winner

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tax one step at a time as you drill down through the nested options. But the nesting goes quite deep, and it's not always obvious where a particular procedure is hidden.

To make matters worse, the editor is feature poor and uses its own nonintuitive set of keystroke commands. Program statements are executed singly or in blocks, also through a set of nonintuitive keystrokes. After execution, you are tossed out of edit mode and back to the menus.

SPSS for Windows lets you run most procedures by making menu selections and answering questions in dialog boxes. The minimized data editor in the lower left of the screen shows the name of the active data file.

The most difficult aspect of the product, however, is that it uses a slightly different command syntax than any other version of SPSS. If you try to execute a program you wrote on another platform, you'll get error message after error message—due to commands or options within commands not supported or designated differently.

The chief advantage of SPSS/PC+ is its modest hardware requirements. You can run SPSS/PC+ on a 286, within 640K of memory if that's all you have. But if you have the hardware, by all means run the Windows version.

SPSS FOR OS/2

Originally released in 1989 for OS/2 1.0, SPSS for OS/2 has received only maintenance upgrades since that time. The latest SPSS maintenance release, Version 4.1, made the product compatible with OS/2, Version 2.0. But the package remains 16 bit and unfortunately does not take advantage of the graphical, object-oriented OS/2 Workplace Shell.

We encountered some problems during installation. OS/2 detected a protection violation during installation of the Trends module and closed down the setup procedure. We reported the difficulty, but the vendor could not duplicate the problem and therefore could not help us. Another undocumented quirk that may catch you by surprise is that you must restart OS/2 after installing the package or it will not run.

SPSS for OS/2 uses a command generator similar to the one found in the DOS product—with the addition of some OS/2-specific menu items. You can either type commands directly into the syntax window or build them up a step at a time by selecting options from the hierarchical menus in the command generator. And like the DOS version, it relies on a third-party product—Excel for OS/2, in this case—for high-resolution graphics. If you don't happen to have Excel for OS/2, you are limited to old-style character-based graphics.

One other note: If you are running OS/2, by all means stick to the OS/2-specific version of SPSS. During testing, we were unable to run either the extended memory version of SPSS/PC+ (apparently because of memory-access problems) or SPSS for Windows (since it needed to be run in an enhanced mode) under OS/2, Version 2.0.

SPSS ON THE INTEL PLATFORM

Which Intel product will get a face-lift next? Not DOS, not OS/2, but Unix! SPSS is working on a Motif version of the product that will run on SCO Open Desktop and Unix System Laboratories' Destiny-based products, in addition to a number of other Unix platforms.

SPSS reports that the future of its DOS and OS/2 versions will depend on how the market responds to the new Windows version, as well as the market demand for OS/2.

SPSS products, particularly the Windows version, are as easy to use as they are powerful. If you are looking for a general-purpose statistics package, without regard for hardware requirements or expense, you can't do better than SPSS for Windows.

SUITABILITY TO TASK

Stata, Version 3.0

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	○	○
Basic statistics	●	●	●	○
Advanced statistics	●	●	●	○

Computing Resource Center

Stata

BY LORI GRUNIN

Stata, Version 3.0, has more in common with your worn old work gloves than with your new cashmere-lined leather ones, but which do you choose when it's time to get your hands dirty? Computing Resource Center's $695 statistical package lacks the interface amenities and high-quality report formatting to which we've become accustomed, but for sheer programmability and for basic analytical power, it has few peers.

The program comes in two versions: Stata, which can run on practically any machine, and Intercooled Stata ($795), which runs in protected mode and thus requires a 32-bit system, 4MB RAM, and a math coprocessor. Both products hold all data in memory while performing operations, so users who think they might bang up against Stata's 6MB ceiling (in practice, about 2 million data points) are advised to opt for Intercooled.

ON THE MENU

You can interact with Stata in two ways: via a dot-prompt command line or via a primitive menu system grafted on top of the command line. The menus are simply forms with spaces for entering different elements of the command (such as by-variables, options, and conditional expressions). Once you have entered all the requisite information, the program jumps

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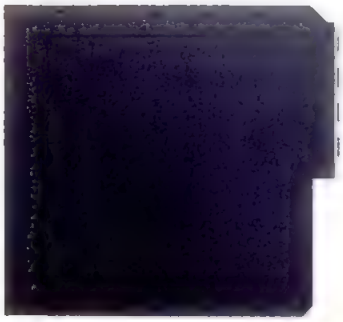

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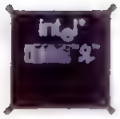

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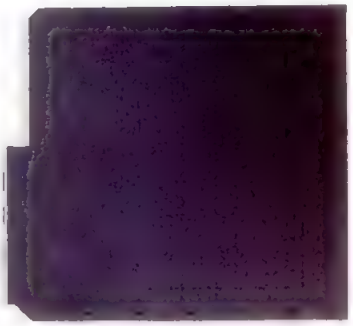

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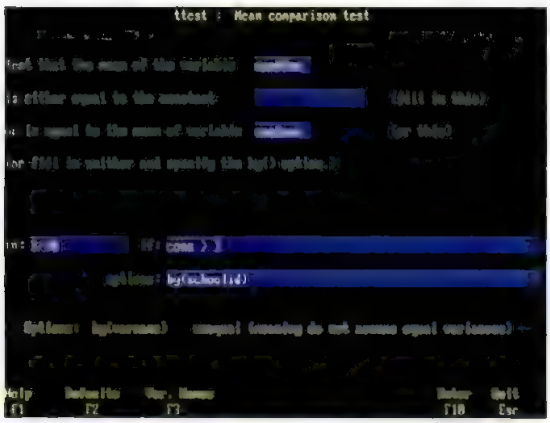

Stata's menu system lets users enter their choices via a form-style interface.

out to the command line and generates the correct program statement for you. (CRC plans to port its Macintosh interface to its other supported platforms.)

Although the menu is too awkward to use very often, it does generate visible command statements and can serve as an excellent tool to help learn the package. The command structure should be easy to pick up for anyone familiar with a statistical package. There are a few irritating inconsistencies, such as the different placements of the "by" statement, which depend on the type of operation you're performing. But for the most part, once you've memorized a few syntax rules, everything behaves the way you think it will. Output for each operation can be suppressed or displayed by specifying "quietly" or "noisily."

You can also create shortcut macros that function similarly to the DOS batch language. Likewise, you will find that generating a basic Stata program is as easy as jumping into a text editor and entering a series of command lines. (Stata leaves you about 252K of free RAM when you shell out to DOS, enough to run a small text editor.)

If you're more ambitious, you can take advantage of the program's looping and branching functions, as well as its ability to question and accept user input. Debugging can be tedious—the program lacks anything close to an integrated debugger—but you will find some clever error-checking tools. The "assert" command, for example, lets you ensure that the data you're getting back matches your preconceptions about it.

MUCH ADO

Stata might be more readily thought of as a statistics "engine." Many of the procedures—robust regression, logit, and survival analysis, to name a few—are actually external interpreted programs called ado-files. When you enter a program name, Stata searches the user-definable ado-path for that file and executes it.

This transparency and power make Stata's extensibility virtually limitless. Computing Resource Center frequently adds new user-submitted routines; you can also subscribe to the Stata Technical Bulletin, a forum for the company and its users to exchange program code and ideas.

While this programming orientation makes Stata nondenominational, it has distinct weaknesses as an off-the-shelf purchase: It lacks multivariate analysis procedures, such as MANOVA (multivariate analysis of variance), and time-series procedures, such as ARMA models. The programming language also lacks matrix handling, so think twice about creating these procedures yourself. (The next version, due out in the second quarter, will support matrices.) Otherwise, Stata ships with a selection of procedures broad and flexible enough to fill three volumes of documentation.

STATA DATA

Getting data into Stata is fairly easy; the program is intelligent enough not to require a data dictionary for simple, clean data sets. It accepts only ASCII files, however. For testing, Computing Resource Center provided us with Circle Systems' Stat Transfer ($129; 206-682-3783, fax: 206-328-4788) for converting .WK* and .XLS files to Stata system files. While Stata has a full complement of data-handling procedures, including recoding, labeling, and intelligent missing-variable processing, a full-screen editor with some search-and-replace capabilities would make data cleaning easier.

Similarly, the package offers a wide range of easy-to-generate two-dimensional graphs and plots that aid in data analysis, but their low resolution makes them less powerful than they might be. For example, accurate analysis requires that circles look like circles, rather than broken ellipses.

The facilities for sprucing up and annotating the graphs are also a long way from state-of-the-art. You can purchase the Stata Graphics Editor ($195), which lets you edit and annotate graphs you've generated. Outline fonts (as opposed to Stata's one-vector font) would go a long way toward improving the look of the output.

Stata certainly won't win any beauty contests, but if you need a package powerful enough to create custom procedures, it should certainly get your vote for Miss Congeniality.

FACT FILE

Stata, Version 3.0
Computing Resource Center, 1640 5th St., Santa Monica, CA 90401; 800-782-8272, 310-393-9893; fax, 310-393-7551

List price: $695.
Requires: 512K RAM, 2MB hard disk space, DOS 2.0 or later.
In short: Stata offers a strong statistics engine with powerful programming and data-management capabilities that can't be beat for creating custom procedures. Those needing advanced multivariate analysis or time-series procedures should steer clear, however, as should nonprogrammers who might be intimidated by the program's lack of any real interface. But those seeking sheer programmability and basic analytical power, look no further; in these arenas, this package has few peers.

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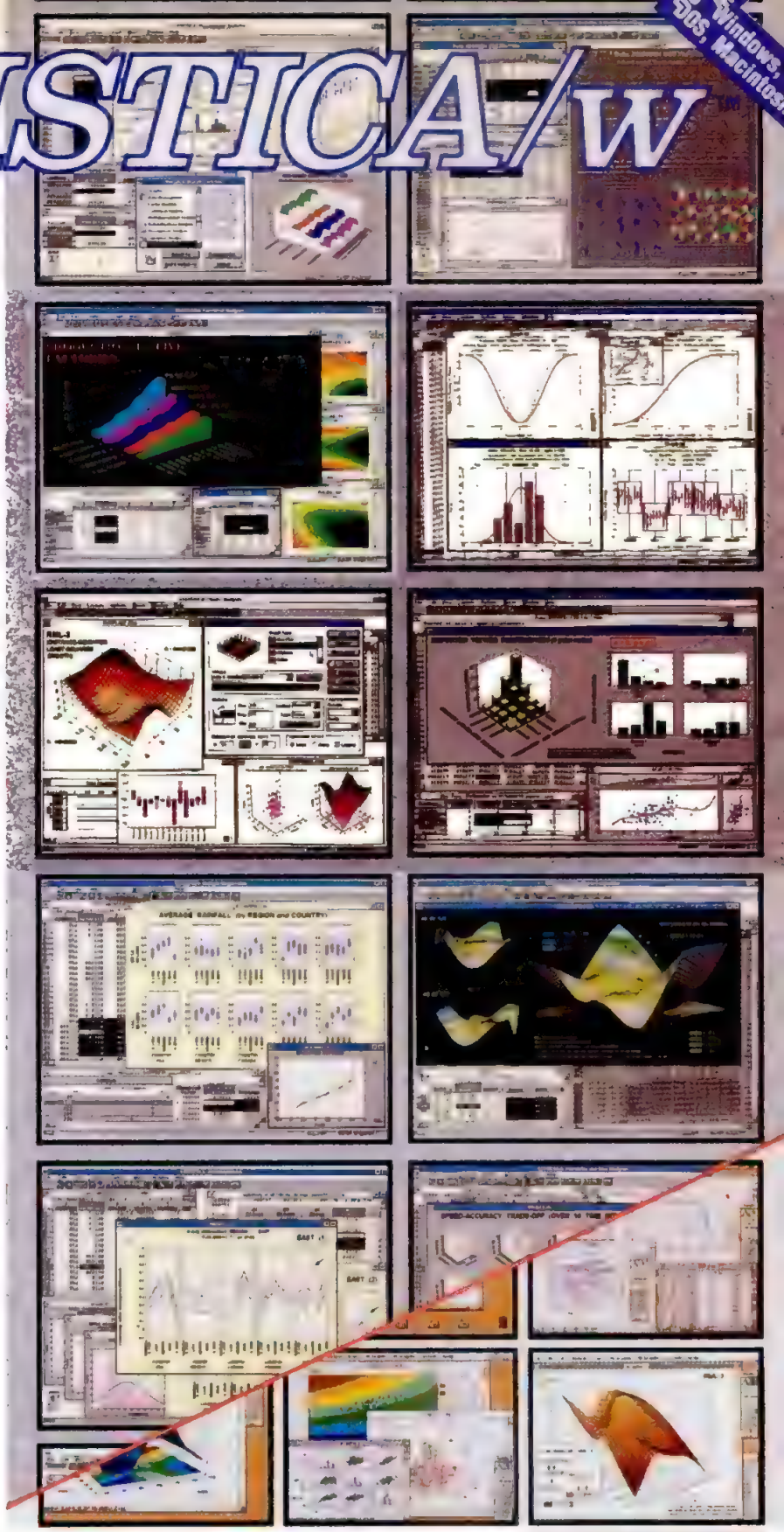
BY DAVID RINDSKOPF

Manugistics' $995 Statgraphics, Version 6, is an interactive program that artfully combines statistics, graphics, and data manipulation in an almost seamless way. With just a few keystrokes, you can do a regression, plot residuals, and pop up

STATISTICA/w™

Windows, DOS, Macintosh



STATISTICA/w™ (for Windows) Complete Statistical System with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Complete Windows 3.1 support, DDE, OLE, TT-fonts, multiple toolbars, right mouse button support ■ Unlimited numbers of data-, results-, and graph-windows ■ Inter-window integration: data, results, and graphs can be treated as objects and converted into one another in a number of ways ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques; multiway tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; survival analysis; time series modeling; forecasting; lags analysis; quality control; process analysis; experimental design (with Taguchi); and much more ■ Manuals with comprehensive introductions to each procedure and examples ■ Hypertext-based Stats Advisor expert system ■ Extensive data management facilities (spreadsheet with long formulas, block operations, advanced Clipboard support, DDE hot links, relational merge, data verification, powerful programming language) ■ Batch command language and macros also supported, "turn-key system" options ■ All output displayed in Scrollsheets™ (dynamic, customizable, presentation-quality tables with toolbars, pop-up windows, and instant 2D, 3D and multiple graphs) ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) ■ Megafile Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE or an extensive selection of file import/export facilities ■ Hundreds of types of graphs, including categorized multiple 2D and 3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom design new graphs and add them permanently to menu ■ On-screen graph customization with advanced drawing tools, interactive stretching and resizing of complex objects, interactive embedding of graphs and artwork, special effects, icons, maps, multi-graphics management, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of all 3D and 4D graphs ■ Extensive selection of tools for graphical exploration of data: fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price **$995**.

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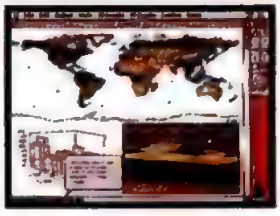

▶ SUMMARY OF FEATURES

Statistics Software

Products listed in alphabetical order

■ = YES □ = NO

	BMDP/386 Dynamic	Genstat	Minitab	NCSS	P-Stat
Operating environment	DOS	DOS	DOS	DOS	DOS
Data Entry, Editing, and Listing					
Import/Export:					
dBASE	□□	□□	□□	□□	■■
SQL	□□	□□	□□	□□	■■
.WK*	□□	□□	■■	■■	□□
Grouped data sets	■	■	□	■	■
Hierarchical data sets	■	■	□	□	■
Data editor	■	■	■	■	■
General Program Capacities					
Maximum number of observations	Limited only by RAM	Limited only by RAM	Limited only by RAM	32,000	Limited only by disk space
Maximum number of variables	Limited only by RAM	Limited only by RAM	1,000	500	3,000
Maximum number of data points	Limited only by RAM	Limited only by RAM	3.1 million	16 million	Unlimited
Matrix manipulation capability	□	■	■	□	■
Maximum length of numeric values	9 digits	128 digits	7 digits	7 digits	15 digits
Maximum length of character values	4 characters	8 characters	80 characters	N/A	999 characters
Publication-quality reports	□	■	□	■	■
General Program Facilities					
Procedural language	■	■	■	□	■
Batch facilities	■	■	■	■	■
Support for memory beyond 640K	■	■	■	□	■
Mouse support	□	□	■	□	■
Command log	■	■	■	□	■
Array variables	□	■	■	□	■
Report writer	□	■	□	■	■
Program output to disk files	■	□	■	■	■
Data set documentation	■	□	□	■	□
Missing values	■	■	■	■	■
Weighting	■	■	□	■	■
Descriptive variable information	■	■	■	■	■
Descriptive text about data file	■	■	□	■	■
Descriptive text for variable values	■	■	■	■	□
Number of reliability tests or item analyses	1	None	None	2	1
Data Management					
Selection:					
Variable subsets	■	■	■	■	■
Case subsets	■	■	■	■	■
Ranges	■	■	■	□	■
Conditionals	■	■	□	■	■
Split-file processing	■	■	□	□	■
Sorting:					
Number of keys	Unlimited	Unlimited	500	5	15
Ascending and descending	■	■	■	■	■
Transpose data file	■	■	■	■	■

N/A—Not applicable. The product does not have this feature.
† Using Stat Transfer, $129 from Circle Systems Inc.

CONTINUES

SPSS for OS/2	SPSS for Windows (PC EDITORS' CHOICE)	SPSS/PC+	Stata	Statgraphics Statgraphics Plus	Statistica/DOS	Systat for DOS	Systat for Windows (PC EDITORS' CHOICE)
OS/2	DOS, Windows	DOS	DOS	DOS, Windows	DOS	DOS	Windows
■■	■■	■■	■■†	■■	■■	■■	■■
■□	■□	□□	□□	□□	□□	□□	□□
■■	■■	■■	■■†	■■	■■	■■	■■
■	■	□	■	□	■	■	■
■	■	□	□	□	■	□	□
■	■	■	■	■	■	■	■
Limited only by disk space	Limited only by disk space	Limited only by disk space	2 billion	Limited only by RAM	Limited only by disk space	Limited only by disk space	Limited only by disk space
32,767	32,767	500	2,047	Limited only by RAM	32,000	250	250
Limited only by disk space	Limited only by disk space	Limited only by disk space	Limited only by RAM	Limited only by RAM	Unlimited	Limited only by disk space	Limited only by disk space
■	■	□	□	■	□	■	■
17 digits	17 digits	17 digits	18 digits	68 digits	16 digits	15 digits	15 digits
255 characters	256 characters	255 characters	80 characters	68 characters	255 bytes	12 characters	12 characters
■	■	■	■	■	■	□	□
■	■	□	■	■	□	■	□
■	■	■	■	□	■	■	■
■	■	■	■	■	■	□	■
■	■	■	□	■	■	□	■
■	■	■	■	N/A	□	■	■
■	■	□	■	■	■	■	■
■	■	■	□	■	□	□	□
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	□	□
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
1	1	1	3	None	2	3	3
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	□	■	■	■	■	■
10	64	64	2,047	2	7	10	10
■	■	■	■	■	■	■	■
■	■	■	■	Optional	■	■	■

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Compaq Computer ... 3 years

9549	ProLinea 4/25s with 240 MB, Windows *(monitor not included)*	$1299.
10891	ProLinea 4/50 with 120 MB, Windows	1699.
10894	ProLinea 4/50 with 240 MB, Windows, 5¼" drive, Modem, Prodigy	1999.
9553	LTE Lite/25c with 120 MB	3499.
9552	Contura 3/25 with 120 MB, Windows	1599.
11416	Contura 4/25cx Active Matrix Color with 120 MB, Windows	3159.
11415	Contura 4/25cx Active Matrix Color with 209 MB, Windows	3399.
11421	Contura 4/25 Mono with 120 MB, Windows	1949.
11420	Contura 4/25 Mono with 209 MB, Windows	2199
11453	Deskpro 4/25s with 120 MB, Windows	1499
11450	Deskpro 4/33i with 120 MB, Windows	1799.
11447	Deskpro 4/66i with 120 MB, Windows	2199.

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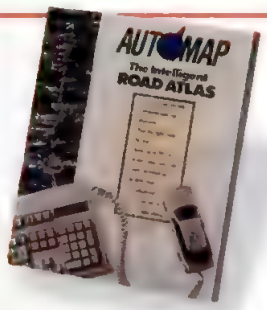
Please call for criteria to qualify to trade up for these popular products. Policies may vary depending on vendor.

	Aldus	
11033	FreeHand Windows Comp Upgrd *(11034 3½")*	145
11038	Persuasion Windows Comp Upgrd *(11039 3½")*	95
11036	PhotoStyler Win Comp. Upgrd *(11037 3½")*	189
	Approach Software	
3830	Approach for Windows Competitive Upgrade	95
	Claris Corp.	
5228	FileMaker Pro 2.0 Competitive Upgrade	89
	Microsoft	
5693	Excel 4.0 Competitive Upgrade *(5695 3½")*	125
8353	PowerPoint 3.0 Comp Upgrd *(8352 3½")*	125
3881	Word for Windows 2.0A Comp Upgd *(7841 3½")*	125



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	AddStor	
8807	SuperStor Pro 1.0	85.
	Adobe Systems	
10774	Adobe Photoshop 2.5 for Windows *(3½" only)*	548
6591	Adobe Illustrator 4.0 for Windows *(6439 3½")*	389
7940	Adobe Type Set Value Pack *(7941 3½")*	39
	(Entire Adobe Type Library available)	
	AGFA	
10396	Discovery TrueType Pack	49.
	Aldus	
1332	PageMaker 5.0 for Win *(April '93) (4247 3½")*	579
	Altsys Corporation	
8675	Fontographer for Windows 3.5 *(3½" only)*	259
	Application Techniques	
8337	WinDings 1.0 for Windows	49
1214	Pizazz Plus 3.0	79.
	Approach Software	
6598	Approach 2.0 for Windows	259
	Area Software	
6030	FontMonger 1.06 for Windows	89
	Artisoft	
2455	Lantastic AE-2 EtherNet Starter Kit 4.1	469.
2452	AE-2 EtherNet Adapter Card	199.
	Automap	
2729	Automap USA for DOS.. 55. 8569 Windows	55
	Avery Dennison	
6006	Label Pro 1.6 *(Laser)*	49.
	Baler Software Corporation	
11312	Baler 6.0	279.
	Banner Blue Software	
2088	Org Plus 1.0 for Windows	125
	Berkeley Systems	
9885	After Dark 2.0 for Windows	29
6649	Star Trek: The Screen Saver *(3½" only)*	34
	Bitstream	
8040	FaceLift 2.0 for WordPerfect 5.0/5.1	69.
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	Borland International	
10616	Quattro Pro Win *(3½" only)*. *while supplies last*	95
10710	Paradox Windows *(3½" only)*. *while supplies last*	129
11445	Paradox/Quattro Pro for Windows Bundle	189
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5900	PC USA 2.0..... 29. 5902 PC Globe 5.0	39.
8855	Print Shop Deluxe 1.0 *(8856 3½")*	45.
	Caere	
4130	Faxmaster 1.0 95. 8933 OmniPage Pro 2.1	629
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9751	Anti-Virus 1.4 *(9555 3.5")* or 8114 Backup 7.1 ea.	89.
5039	PC Tools 8.0 *(1475 3½")*	125.
11394	PC Tools for Windows *(11395 3½")*	125
	Claris Corp.	
10996	ClarisWorks for Windows *(Apr '93)*	95
5257	FileMaker Pro 2.0 for Windows	119
	CompuServe	
7546	DOS Membership Kit 2.0	25.
10957	Windows Membership Kit 1.0	27
	Concentric Data Systems	
6575	R& R Report Writer DOS 159. 9236 Windows	159
	Contact Software	
7435	ACT! for Windows	239
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5506	CorelDRAW! 3.0 *(5508 3½")*	395
	Data Storm	
4798	PROCOMM PLUS 2.01 69. 6918 for Windows	99
	DCA/Crosstalk	
5611	Crosstalk 2.0 for Windows	$119
	Delrina Technology	
5974	DOSFax PRO... 49. 2446 WinFaxPro 3.0	79
10454	Windows Communications PAK	145
	DeltaPoint	
10787	Animated Desktop 1.0 for Windows	42
5172	FreezeFrame 1.0 for Windows	62
	Fifth Generation Systems	
7725	Direct Access 5.1	64.
3950	Fastback Plus.... 95. 6431 for Windows	95
	Fractal Design	
7822	Sketcher 1.0 for Windows	94
	Gibson Research	
9832	SpinRite 3.1	85.
	Hewlett-Packard	
8731	Dashboard 1.0 for Windows	45
	IBM	
7303	OS/2 2.0 Upgrade from DOS *(7305 3½")*	99.
	Inset Systems	
7298	HiJaak 2.1.. 115. 3820 1.0 for Windows	115
	Intuit	
2426	Quicken 5.0.. 45. 5596 for Windows	45
	LaserTools	
6882	PrintCache 3.1	49.
9510	PrimeType 1.0 for WordPerfect	62.
	Leister Productions	
11406	Reunion for Windows	135
	Lotus	
5417	1-2-3 3.4 *(5416 3½")*	399.
5653	1-2-3 2.4 *(5652 3½")*	335.
2755	1-2-3 1.1 for Windows *(2756 3½")*	309
3424	1-2-3 1.1 for Windows Upgrade *(3428 3½")*	99
5799	Ami Pro 3.0.. 239 1847 Competitive Upgrd	99.
3523	Freelance Graphics 2.0 for Windows *(5005 3½")*	349
10753	Improv for Windows *(3½" only)* *intro. price*	99
1493	Organizer for Windows	99
5981	SmartSuite *(5982 3½")*	469
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11370	Rome..... 29. 11423 El-Fish *(3½" only)*	35.
	MECA	
2798	Managing Your Money 9.0	32.
	Microcom	
6234	CarbonCopy Plus 6.1.. 129. 4410 Windows	129
	Micrografx	
3627	Windows Draw! 3.0 *(3628 3½")*	99
	MicroLogic Software	
5350	TrueType 1.0 for DOS 49. 8579 MoreFonts 3.0	75.
	Microsoft	
10051	Font Pack 2 for Windows	45
11324	MS-DOS 6 Upgrade *(11325 3½")*	47.
7010	Windows 3.1 *(7009 3½")*	89
6141	Windows for Workgroups Add-on *(6172 3½")*	59
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10056	FoxPro 2.5 for Windows *(10057 3½")*	299
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	Nolo Press	
2982	WillMaker 4.0	35.

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10582 myHouse 59.
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4586 DESQview 386 2.4 *(4585 3½")* 129.
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Shapeware
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5147 Orbits 1.0 36. 5145 Bodyworks 2.14 45.

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11304 PC Anywhere 1.0 for Windows *(11303 3½")* 129
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WordPerfect Corporation
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3804 WordPerfect *(3795 3½")* 269.
3494 WordPerfect for Windows *(3497 3½")* 279
XTree
8328 XTree 1.5 for Windows *(8957 3½")* 65
6161 XTree Gold 2.5 95.

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Warranties listed next to manufacturer.

3 Com ... lifetime (conditional)
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7108 Smart UPS 400 339. 7105 Smart 600 439.
3819 Back-UPS 250 115. 3858 Back 400 179.
7107 Back-UPS 450 215. 3823 Back 600 295.
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1345 OPTIMA 24 Modem 115 3522 OPTIMA 96 349.
8187 OPTIMA 24+FAX96 119.
7395 OPTIMA 144+FAX144 389.
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4750 80387SX 79 5409 80387DX 85.

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10748 MasterPiece Compact ... 59.
10410 NoteBook Traveler PC Deluxe Case ... 75
7899 Expert Mouse *serial*... 99. 7900 *bus* ... 115.

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10603 CC3144 14.4 credit card Fax/Modem ... 499

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10555 TheComplete Modem with RapidFAX ... 89.
8593 TheComplete Communicator Gold ... 389.

Tripp Lite ... 2 years
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6200 Isobar 6-6 *(6 outlets, Gold Seal Warranty)*... 59.
9312 BC500 Power Backup ... 219.

Video Seven ... 7 years
7362 WIN VGA 1 MB *(1024 x 768, 256 color)* ... 129.
9261 WIN PRO 1 MB *(1024 x 1024, 256 color)* ... 179.

Zoom Telephonics ... 7 years
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1307 Internal 2400 Baud with 9600 Baud Fax Modem 69
1178 Ext 2400 Baud with 9600 Baud Fax Modem ... 92.
1494 Ext 9600V 32..... 195. 3075 Internal ... 179
3386 FaxModem AFC *(2400 baud 96S/48R)* ... 49
4430 FaxModem AFX *(2400 baud 96S/48R)* ... 69.
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1337 CP30204 210 MB IDE HD *(16 ms)* ... 369

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6344 PC Powered 90 PRO *(includes PC2B, cartridge & Central Point Software)*... 599.
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2530 90 MB Cartridge..... 149. 2467 Tripak ... 439.
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10702 Tape250 Parallel Port Tape Backup ... 429.
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6581 CDR84 Internal CD-ROM *(reqs. interface)* ... 569.

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8736 Infinity 88 MB Removable *(Syquest)* ... 539

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4714 Hardcard EZ 240 MB IDE *(16 ms)* ... 549

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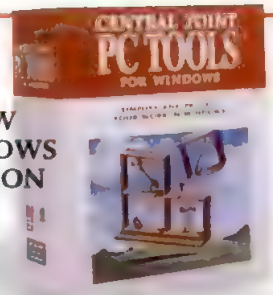
4670 1.44 MB Drive for PC/XT (3½") ... 55
4326 1.44 MB Drive for AT (3½", *with Bastech*) ... 75
4414 3½"/5¼" Dual Floppy Drive ... 145.



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6556 256k DRAMs *(100 nanosecond, set of 9)* ... call
5510 1 MB x 9 SIMMs *(80 nanosecond)* ... call
2497 4 MB x 9 SIMMs *(80 nanosecond)* ... call
5746 1 MB Chips *(80 nanosecond, set of 9)* ... call

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Fuji ... lifetime
2214 3½" DS Disks*(10)*..... 9. 2242 *(50)*.... 32.
7379 3½" HD Disks*(11)*..... 13. 2241 *(50)*.... 59.
4863 3½" HD Disks *(20)* with storage case ... 26.

Sony ... lifetime
3292 5¼" HD Disks*(Qty. 10)* ... 11.
3297 3½" DS Disks *(10)*..... 9. 6148 *(30)*... 25.
3298 3½" HD Disks *(10)*.... 14. 6375 *(30)*.. 39.
8185 QD2040 ... 14. 1895 QD2120 ... 19.

3M ... lifetime
1581 DC2120..... 22. 11013 *(3 pack)*... 60.

Toshiba ... lifetime
4858 3½" 2.88 MB ED Disks *(Qty 5)* ... 17.
9755 3½" 2.88 MB ED Disks *(Qty. 10)* ... 29.

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SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	BMDP/386 Dynamic	Genstat	Minitab	NCSS	P-Stat
Data Management (continued)					
Data transformations:					
Spreadsheet interface	□	□	■	■	□
Menu input of transformation	□	□	■	■	■
Algebraic input of transformation	■	■	■	■	■
Probability functions	■	■	■	■	■
Inverse probability functions	■	■	■	□	■
Lead	■	■	□	■	■
Lag	■	■	■	■	■
Tables					
Single, multiway tables	■	■	■	■	■
Stub-and-banner tables	□	□	□	■	■
Chi-square test of independence	■	□	■	■	■
Measures of association besides chi-square	■	□	□	■	■
Descriptive statistics for breakdown tables	■	■	■	■	■
T-Tests (Univariate)					
Independent samples	■	■	■	■	■
Matched pairs	■	■	■	■	■
Number of correlation procedures	5	5	3	5	5
Regression					
Linear regression:					
Standard multiple	■	■	■	■	■
Automatic subset selection	■	■	■	■	■
All possible subsets	■	■	■	■	■
Weighted regression	■	■	■	■	■
Basic residuals analysis	■	■	□	■	■
Extended-regression diagnostics	■	■	□	■	□
Colinearity diagnostics	■	■	■	■	□
Nonlinear regression:					
General	■	■	■	■	■
Allows function, derivative specification	■	■	□	■	■
Derivative-free method available	■	■	□	■	■
Logistic	■	■	□	■	□
Probit	■	■	□	■	□
Censored regression	□	■	□	■	□
Robust regression	■	■	■	■	■
Ridge regression	■	□	□	□	□
Generalized linear models (GLMs)	□	■	■	■	□
General covariance structure analysis	■	■	□	□	□
Designed Experiments and Analysis of Variance					
Algebraic (factorial) design specification	■	■	□	■	■
ANOVA (analysis of variance)	■	■	■	■	■
ANCOVA (analysis of covariance)	■	■	■	■	■
Nested designs	■	■	■	■	■
Contrasts and planned comparisons	■	■	□	■	■

N/A—Not applicable: The product does not have this feature

CONTINUES

SPSS for OS/2	PC EDITOR'S CHOICE SPSS for Windows	SPSS/PC+	Stata	Statgraphics Statgraphics Plus	Statistica/DOS	PC EDITOR'S CHOICE Systat for DOS	Systat for Windows
☐	■	■	☐	■	■	■	■
■	■	■	■	☐	☐	■	■
■	■	■	■	■	■	■	■
■	■	☐	■	■	■	■	■
■	■	☐	■	■	☐	■	■
■	■	■	■	■	■	☐	☐
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	☐	■	☐	☐
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	N/A	N/A
■	■	■	■	■	■	■	■
■	■	■	■	■	☐	■	■
5	5	5	4	5	5	5	5
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
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■	■	■	■	■	☐	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	☐	■	■	■	■
■	■	■	■	☐	■	■	■
■	■	■	☐	☐	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	☐	■	■	■
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■	■	■	☐	☐	☐	■	■
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■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■

SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	BMDP/386 Dynamic	Genstat	Minitab	NCSS	P-Stat
Designed Experiments and Analysis of Variance (continued)					
Posthoc tests	■	■	■	■	■
Power analysis	□	■	□	■	□
Multivariate Analyses of Variance					
Factor analysis:					
Principal components	■	■	□	■	■
Maximum likelihood factoring	■	■	□	□	□
Confirmatory analysis	■	□	□	□	□
Rotation of factor loadings	■	■	□	■	■
Factor scores	■	■	□	■	■
Cluster analysis	■	■	□	■	■
Multidimensional scaling	□	■	□	■	□
Discriminant analysis	■	■	■	■	■
Number of nonparametric methods	8	7	5	8	9
Number of time-series procedures	9	8	4	7	4
Number of life-table or survival-analysis procedures	4	None	1	4	2
Number of quality-control or product-improvement tests	None	None	3	4	1
Graphics					
Boxplots	□	■	■	■	■
Histograms	■	■	■	■	■
With curve fitting	□	■	□	■	□
Stem-and-leaf	■	□	■	■	■
Line graphs	□	■	■	■	■
Pie charts	□	■	□	■	□
Scatterplots	■	■	■	■	■
Plots regression lines	■	■	■	■	■
Plots least-squares confidence bands	□	■	■	■	□
Multiple plots on one page	■	■	□	■	■
Dynamic brushing	□	□	□	■	□
Three-dimensional graphs	□	■	□	■	□
Spiked plot	N/A	□	N/A	■	N/A
Projection lines plot	N/A	■	N/A	■	N/A
Regression plane plot	N/A	□	N/A	■	N/A
Ridge plot (contour plot)	N/A	■	N/A	■	N/A
Point cloud rotation	N/A	□	N/A	■	N/A
General-function plot	N/A	■	N/A	■	N/A
Multidimensional	□	■	□	■	□
Mapping	□	□	□	■	□
Interactive visual data manipulation	□	□	□	■	□
WYSIWYG chart editing	□	□	□	□	□
Output Devices					
Laser printers	■	■	■	■	■
Plotters	■	■	■	■	□
Color printers	■	□	■	■	□

N/A—Not applicable: The product does not have this feature

ENDS

SPSS for OS/2	SPSS for Windows (PC Editors' Choice)	SPSS/PC+	Stata	Statgraphics Statgraphics Plus	Statistica/DOS	Systat for DOS (PC Editors' Choice)	Systat for Windows
■	■	■	■	■	■	■	■
■	■	■	□	■	□	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	□	□	□
□	■	■	■	□	□	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	□	■	■	■	■
■	■	■	□	□	■	■	■
■	■	■	□	■	■	■	■
9	9	8	9	9	8	8	9
9	9	8	1	8	9	7	7
3	4	2	4	3	4	4	5
None	2	2	1	3	3	1	1
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
□	■	■	■	■	■	■	■
□	■	■	■	■	■	■	■
□	□	□	□	■	□	□	■
□	□	□	□	■	□	□	■
□	■	■	□	■	■	■	■
N/A	■	■	N/A	■	■	■	■
N/A	■	■	N/A	■	■	■	■
N/A	□	■	N/A	□	■	■	■
N/A	□	■	N/A	■	■	■	■
N/A	■	□	N/A	■	■	■	■
N/A	□	■	N/A	■	■	■	■
□	■	□	□	■	■	■	■
□	□	■	□	□	□	■	■
□	□	□	□	■	■	□	■
□	■	■	□	■	■	□	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	□	■	■	■	■

a screen to create a new variable to be used in the next step of the regression. The program is strong in graphics, quality-control procedures, response surface graphs, time series analysis, and experimental design (an area addressed by few general statistics packages).

Learning the program and getting help couldn't be easier. Installation is simple and fast. The documentation is clear, well organized, and formatted superbly for ease of understanding. The support personnel were pleasant and able. Help is also available by telephone, mail, fax, and modem. On-line help, however, is only fair; a few simple examples would be useful to illustrate the nature of allowable inputs for some menu fields.

The DOS version was used in our tests, but for those with at least 4MB of RAM and a 386-based PC or better, the $1,595 Statgraphics Plus (essentially a DOS version that can use extended memory and run in a DOS box under windows) offers additional features, such as a wide range of Bitstream fonts for graphics, faster operation, and the ability to handle extremely large files. Both versions support a wide variety of printers and plotters, including PostScript and HP-compatible printers, as well as HPGL-compatible printers and plotters.

SUITABILITY TO TASK

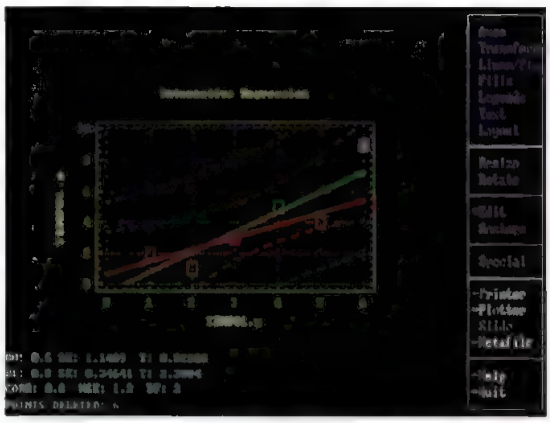
Statgraphics, Version 6
Statgraphics Plus, Version 6

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	●	○
Basic statistics	●	●	●	○
Advanced statistics	●	●	●	○

SOME EXTRAS

Statgraphics contains some features that were not commonly found in statistics packages until recently: A procedure called Interactive Outlier Rejection lets you plot data with a regression line, highlight an outlying point, and see how the line would change with the point removed. Mathematical procedures such as linear programming, numerical differentiation, and quadrature are available. Another procedure analyzes nested designs, producing variance components.

The pop-up expression window, a built-in calculator that also deals with matrices and creates new variables, lets you perform tasks that are not otherwise included in the package. For example, what Statgraphics calls *Lifetime Data Analysis* is actually its reliability procedure. With it, you can easily calculate and save the correlations among the items, pop up the expression window to find the average correlation, and write the required reliability formula using the saved computations.



Interactive Outlier Rejection: Using the cursor, we have picked a point, marked X, to delete.

NOT LIKE THE OTHERS

Statgraphics operates in a unique fashion that makes a lot of sense. Consider how it handles data files and variables. If several files contain data on the same people, you can easily pick some variables from each file to use in an analysis without having to first merge the files. Or suppose you want to assign the same labels to a series of variables. You create a new character variable that contains the labels and then indicate that this new variable contains the labels for whichever other variables you desire. This unusual organization makes certain tasks very easy.

With its nontraditional way of doing things, Statgraphics might benefit from a documentation section called "Tricks and Tips," which would help more traditional users get off to a fast start. The most important such tip is that if you want to guard against inadvertent errors, or if you want to do a complex task again with slight variations, create a macro that will capture your keystrokes and save a record of them. This will allow you to repeat the task or edit the macro to make any desired changes.

Editing a macro now requires you to write the macro to an ASCII file, exit the program, edit the ASCII file, restart Statgraphics, import the macro, and then run it. The developers say they know this is clumsy and are working on a built-in macro editor. The dearth of macros is one of the weak points of Statgraphics. Interactive computing can be fun, but if you want to run similar analyses of many data sets or variables, or if you want to modify an earlier run slightly, you need the ability to batch process a set of commands.

The program has a few other weaknesses. In principle, the number of variables the program can handle is practically unlimited. But if you want to import a data set with more than one record per case, you are either out of luck or forced

FACT FILE

Statgraphics, Version 6

Statgraphics Plus, Version 6
Manugistics Inc., 2115 E. Jefferson St., Rockville, MD 20852; 800-592-0050, 301-984-5123; fax, 301-984-5094

List price: $995; $1,595.
Requires: 640K RAM, 6MB hard disk, DOS 3.0 or later; 4MB RAM, 7MB hard disk space, DOS 3.3 or later, space for work files and fonts.
In short: Statgraphics is an interactive program that smoothly integrates statistics, graphics, and data manipulation. Especially strong are its graphics, time series, experimental design, and quality-control capabilities. The package's major shortcomings are that it is limited to reading one record per case and unable to modify variable specifications easily or conduct large numbers of similar analyses on different variables. Statgraphics also lacks a few multivariate procedures and options.

472 ON READER SERVICE CARD

to invent a method to handle what is a very common situation.

Our testing involved entering variable names and labels. We looked at what might happen if you inadvertently skipped a variable in the middle and found there was no way to recover from this by simply moving everything down one line. We found that you have to retype everything from the point of the error. Also, there is no easy way to read a second data set using the same or similar variable names and labels as the first.

As with most general packages, some procedures are missing, such as MANOVA (multivariate analysis of variance) and logistic regression. And the procedures that are present are sometimes limited; in factor analysis, only one estimation method is available, and no oblique rotation methods are included. In cluster analysis, no dendrogram ("tree chart") is drawn, and the only proximity measures are Euclidian and correlations.

Although Statgraphics has no built-in programming language, it can be used in conjunction with Manugistics' APL*Plus to perform almost any conceivable calculation. Statgraphics has hooks that allow you to write your own routines in APL and run them from within Statgraphics.

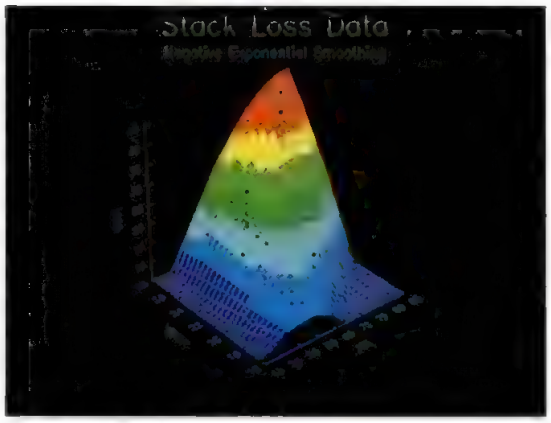
Statgraphics offers a wide range of statistical, graphical, and data manipulation capabilities. Many users will find it fills all of their needs, providing sought-after tools unavailable in other packages and proving a valuable addition to their armament of statistical-analysis tools.

StatSoft Inc.

Statistica/DOS

BY GRANT BLANK

Statistica/DOS, Version 3.1 ($795), from StatSoft is a comprehensive, menu-driven package with excellent graphics. Statistica/DOS is particularly strong when used with small data sets requiring uncomplicated transformations. A Windows version that has additional graphics capabilities, Statistica/w, will ship soon.



Statistica for DOS offers a wide range of customizable presentation and analytic graphics.

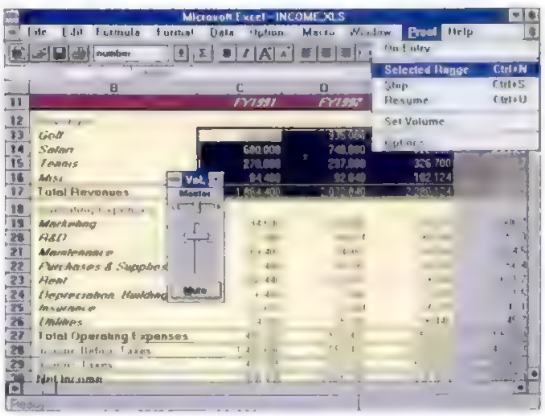
The entire package (previously called both CSS: Statistica and CSS/3) is intended to be used interactively. For example, in statistical procedures, menus prompt users to specify a model or design. Statistica/DOS calculates the model and displays additional menus, allowing users to choose the results or diagnostics they want to see. Statistics are displayed in formatted tables called "scrollsheets." They can be printed or saved to a disk file, and any column or row can be graphed. A weakness is that groups of scrollsheets generally cannot be printed; they have to be chosen and printed one at a time. Skimpy help files also hamper interactive use.

HIGH GRAPHICS

Supplementing the scrollsheets are a wide selection of high-resolution graphics, including three- and four-dimensional plots, as well as histograms, box plots, and others. All statistical procedures provide diagnostic plots. Graphics can be customized in a variety of ways. The integration of graphics and statistics is one of the package's strengths. For example, clicking on a cell in a correlation matrix will produce a scatterplot that can be edited, annotated, saved, or printed.

Among the statistical procedures, the ANOVA/MANOVA (analysis of vari-

What business does sound have in a computer?



For starters, you can increase your productivity when you proof spreadsheets with the new Microsoft Windows™ Sound System. Just highlight a series of numbers or words on the screen and it will read them back to you. It will even read them aloud as you enter them, if you like. To hear more, turn the page.

ance/multivariate analysis of variance) procedure is particularly strong and able to handle very large designs. The package is also notable for the speed of its statistical processing.

STATISTICALLY SIGNIFICANT

We found some significant weaknesses, however. Some specialized procedures cannot save output to a data file. All you can do is print them or save them to an ASCII file as a scrollsheet. This limits your ability to do more complex analyses or produce diagnostics other than those built into the package. Statistica/DOS supports only one missing data type, integer weights, and is weak in stub-and-banner tables. This makes it unsuitable for analysis of marketing or survey data. Statistica/DOS has a batch language, but it can do only basic operations and sometimes not even those. It can't, for example, produce frequency tables. This makes the package unusable for those who do repetitive analyses or need to document how they did their work. The transformation language is very capable, but insufficiently documented.

Data handling is provided in the module Data Management, which handles up to 300 variables, and the module Megafile Manager, which handles up to 32,000 variables. Both can do data transformations and multiple file operations, but Megafile Manager is more capable. Basic statistics are available in Megafile Manager, but most statistics and all graphics require using files no larger than 300 variables. The idea is to use Megafile Manager to maintain a large database and extract subsets for statistics.

The two file managers are unique to this package, but they are awkward because they don't translate files between each other very well. Most statistical operations require that you refer to variables by number, not name. Since the numbers are in the ordinal position in the analysis data set, when you convert different files from Megafile Manager, the same variable may have a different number. You will find that keeping track of the numbers is tedious, and errors are easy to make. Also, you cannot reorder the variables.

The documentation is voluminous but obscure. Many options on the menus are not described or are described incompletely. There are far too few examples, and the limits of various procedures are almost never stated. The index is even more frustrating; we were dismayed by how few statistical procedures and plots were accurately indexed.

THE TWO FACES OF STATS

The package seems to have a split personality. Its advanced capabilities, such as graphics and the integration of graphics and statistics, are offset by features that feel like statistical computing in the 1960s. The "old" feeling is exemplified by the program's use of variable numbers and its weak character-variable support. Similarly, categorical data analysis procedures expect data to be arranged as small consecutive integers and often refuse to run (or produce unwanted results) when used with noninteger or nonconsecutive data. With certain exceptions too complicated to detail here, analysis files do not support character variables; they support only labels that can't be manipulated as text. These problems force users to remember arbitrary things such as the current contents of variable 287 or to take extra steps to convert their data to a form usable by the procedure. Statistica/DOS forces users to work with the internal representation of data programmed in the statistical procedures. This is unnecessary given modern data structures. Worse, it makes interactive work considerably harder.

We looked at a prerelease copy of the Windows version, Statistica/w. It will add the ability to put multiple scrollsheets on a screen. It will also feature additional graphics capabilities, including scatterplot brushing and on-screen resizing of graphics. And it will have a wide variety of graphic-editing and annotation tools. The Windows product appears to be as fast as the current DOS application. Statistica/w will also save scrollsheets (but generally not other output) to a file and handle larger problems than the DOS version could. But it will add only a few new statistical capabilities. Statistica/w's file handling will be identical to the DOS version's.

Statistica/DOS is one of the few large and comprehensive packages that is meant to be solely used interactively. Such an attempt works best for data sets with few variables or for simple designs that don't require extensive data transformation or complex file management.

SUITABILITY TO TASK

Statistica/DOS, Version 3.1

Data management	●	●	○	○
Basic statistics	●	●	●	○
Advanced statistics	●	●	●	○

FACT FILE

Statistica/DOS, Version 3.1
StatSoft Inc., 2325 E. 13th St., Tulsa OK 74104; 918-583-4149; fax, 918-583-4376

List price: $795.
Requires: 540K RAM, 13MB hard disk space, DOS 2.1 (3.0 or later recommended).
In short: Statistica/DOS is a fast, integrated statistical package. Its strengths are its excellent graphics and close integration of graphics and statistics. Designed to be completely menu driven, it works best for files with few variables needing only simple transformations. It cannot handle large or complex files as easily as other packages. Another weakness is that groups of scrollsheets generally cannot be printed; they have to be chosen and printed one at a time. The package is also weak in analysis of marketing and survey data
473 ON READER SERVICE CARD

Systat Inc.

Systat for DOS
Systat for Windows

BY SHERYL CANTER AND CHARLES KADUSHIN

Systat, available on the PC platform for both Windows and DOS, combines exceptional strengths with some surprising weaknesses. It boasts one of the strongest graphics feature sets available, and its statistical algorithms are highly accurate and efficient. Systat 5.01 for Windows requires a modest 8MB of disk space and 2MB of RAM (4MB recommended). The DOS version uses only 7.5MB of hard disk space and 640K of memory. Moreover, Systat is one of the most reasonably priced pack-

ages in this roundup. Both the DOS and Windows packages are priced at $895.

But Systat is limited to 256 variables, and it forces you to give up a variable for each value label you want. Variable labels aren't supported. These shortcomings seem incongruous in a package with such sophisticated features.

The folks at Systat believe that graphics are a crucial component of statistical analysis, and the package certainly delivers in the graphics department. The charting options for both the DOS and Windows versions are more extensive than those of any other package on the market. Further, the Windows version supports interactive graphics. With the data editor open, you can use the "lasso" tool to identify a data point on a scatterplot; a bullet will appear next to the corresponding case number in the data editor. If you choose, you can then conditionally drop the data point and generate the graph again. The Windows version also lets you size graphs with your mouse and provides a WYSIWYG editor that lets you make annotations directly.

Such strong opinions about statistics are also evident in the design of the package. For example, the Systat position on overwriting data files is that you shouldn't; if you've changed the active data set through sorting or recoding and want to save it, you should use a different name. Unless you are using the data editor, you cannot make changes to a data file and then save it to disk with the same name. While it's true that unfortunate mistakes can be made when overwriting is allowed, with this restriction you will tend to accumulate a large number of data files with uninformative names, such as survey1.sys, survey2.sys, and so on.

Systat is geared toward the academic market, and its manuals give the computing algorithms for the statistical procedures, in case you are curious. Add-on packages (written by recognized statisticians) for advanced procedures such as survival analysis and time series analysis are available, but only for the DOS version. The director of technical support is a statistician with a Ph.D. who can be reached by telephone.

SUITABILITY TO TASK

Systat 5.03 for DOS
Systat 5.01 for Windows

	POOR	FAIR	GOOD	EXCELLENT
Data management	●	●	●	○
Basic statistics	●	●	●	●
Advanced statistics	●	●	●	○

STRONG COMMAND LANGUAGE

You don't have to write code in Systat unless you want to; the program's well-designed pull-down menus let new users get started quickly. But a command line is provided for experienced users, and a built-in text editor enables those so inclined to write full-fledged programs.

FACT FILE

Systat 5.03 for DOS

List price: $895, $626.50 for academia and government; upgrade discounts available.

Requires: 640K RAM, 7.5MB hard disk space (can run on high-density floppy disks), DOS 3.0 or later.

In short: The basic package intelligently performs almost all statistical routines that sophisticated users might require. Brilliant graphics alone are worth the price, but this package is harder to use than the Windows version, and it lacks WYSIWYG editing.

PC MAGAZINE EDITORS' CHOICE

Systat 5.01 for Windows

List price: $895 for commercial, $637 for academia and government; upgrade discounts available

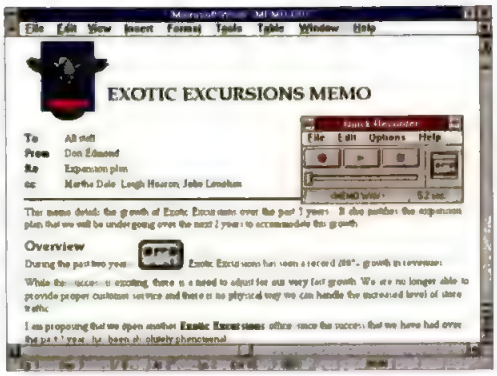
Requires: 2MB RAM (4MB recommended), 8MB hard disk space, Microsoft Windows 3.1.

In short: Systat boasts superb graphics, high-quality statistical algorithms, and a reasonable price point. The graphics are interactive, and there is a WYSIWYG editor for on-screen annotations. Shortcomings in Systat's data-management and documentation facilities, however, make it ill-suited for large corporate data sets.

Systat Inc., 1800 Sherman Ave., Evanston, IL 60201-3793; 708-864-5670; fax, 708-492-3567

474 ON READER SERVICE CARD

What business does sound have in a computer?



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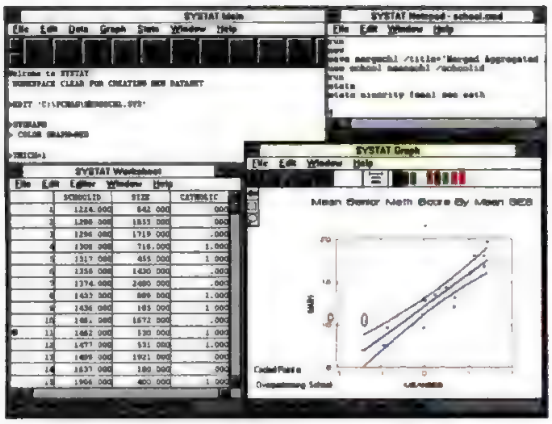

This screen shows a bulleted Systat data worksheet and the case whose point is circled on the graph.

A dialect of BASIC, tailored to the needs of statisticians, serves as the command language. There are special commands for merging files, recoding variables, and reading hierarchical data. You can also read ASCII data in free-field or fixed-field format. The command for reading fixed-field data has options to handle complex and nested file structures, but it is cryptic and terse, using symbols such as carets and pound signs, rather than descriptive English words. This tendency, evident in other parts of the language as well, can make programs difficult to read and to debug. Uninformative error messages such as "Unable to understand what you mean here" only make the situation worse.

Although Systat's BASIC is anything but self documenting, the manuals make no mention of the available remark (REM) statement. If you don't have prior BASIC experience, you may not know that you can comment your program with statements starting with REM.

Despite its shortcomings, Systat's BASIC is a powerful language that can be used effectively to extend the product. Sysnet, a newsletter sent to all registered users, includes tips on how to combine Systat procedures with Systat's BASIC in order to compute statistics that do not come with the package.

SOME NOTABLE LIMITATIONS

Powerful as it is, Systat suffers from some fundamental limitations. It contains no report writer for designing presentation-quality reports. Output must be written to an ASCII text file and then imported to a word processor. And output options are limited. For most procedures in the Windows package, there are only two: short and long. The DOS version, though, supports short, medium, and long.

Systat cannot readily change the data type of variables, a facility commonly used for cleaning data. To accomplish this, you must go through the circuitous procedure of writing the file to disk and then reading it back in.

Systat cannot label variables in an ASCII file—a serious drawback since names are limited to eight characters. As the number of variables in a data set increases, variable names inevitably turn cryptic, and you will need a code book to read the output.

Labeling the values of categorical variables is possible but a nuisance. Systat labels categorical variables by creating a new character variable in which the labels are the values. For example, if you had a numeric variable called SEX, where 0 was the code for male and 1 was the code for female, you'd have to create a second character variable that stored the words *Male* and *Female* instead of the numbers 0 and 1. Not only does this approach use up unnecessary disk space, it can severely cut into the product's 256-variable limit!

In the DOS version, data set titles—labels that users may add to document the data set—are only displayed when a data set is first opened; they are not part of the output from statistical procedures. This shortcoming, in conjunction with the lack of variable labels, can make reading the output from statistical procedures very difficult indeed.

But these limitations only become truly serious when dealing with relatively large data sets. If you work primarily with the smaller data sets common in experimental work, Systat—with its superb graphics, high-quality statistical algorithms, and reasonable price—is an excellent choice. Business analysts who deal routinely with large data sets, however, may prefer to look elsewhere. □

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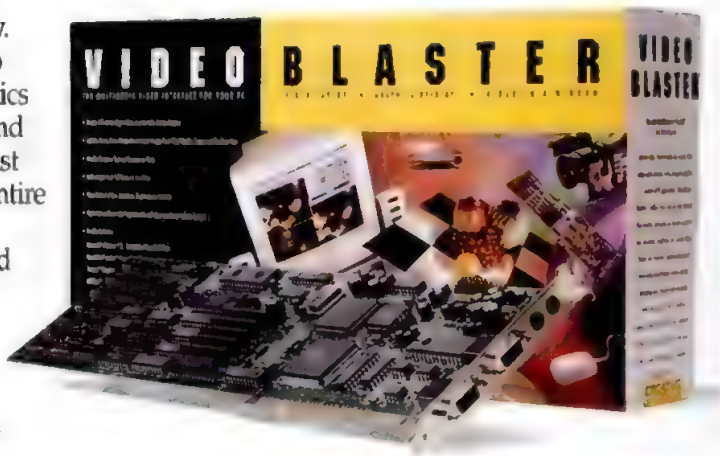

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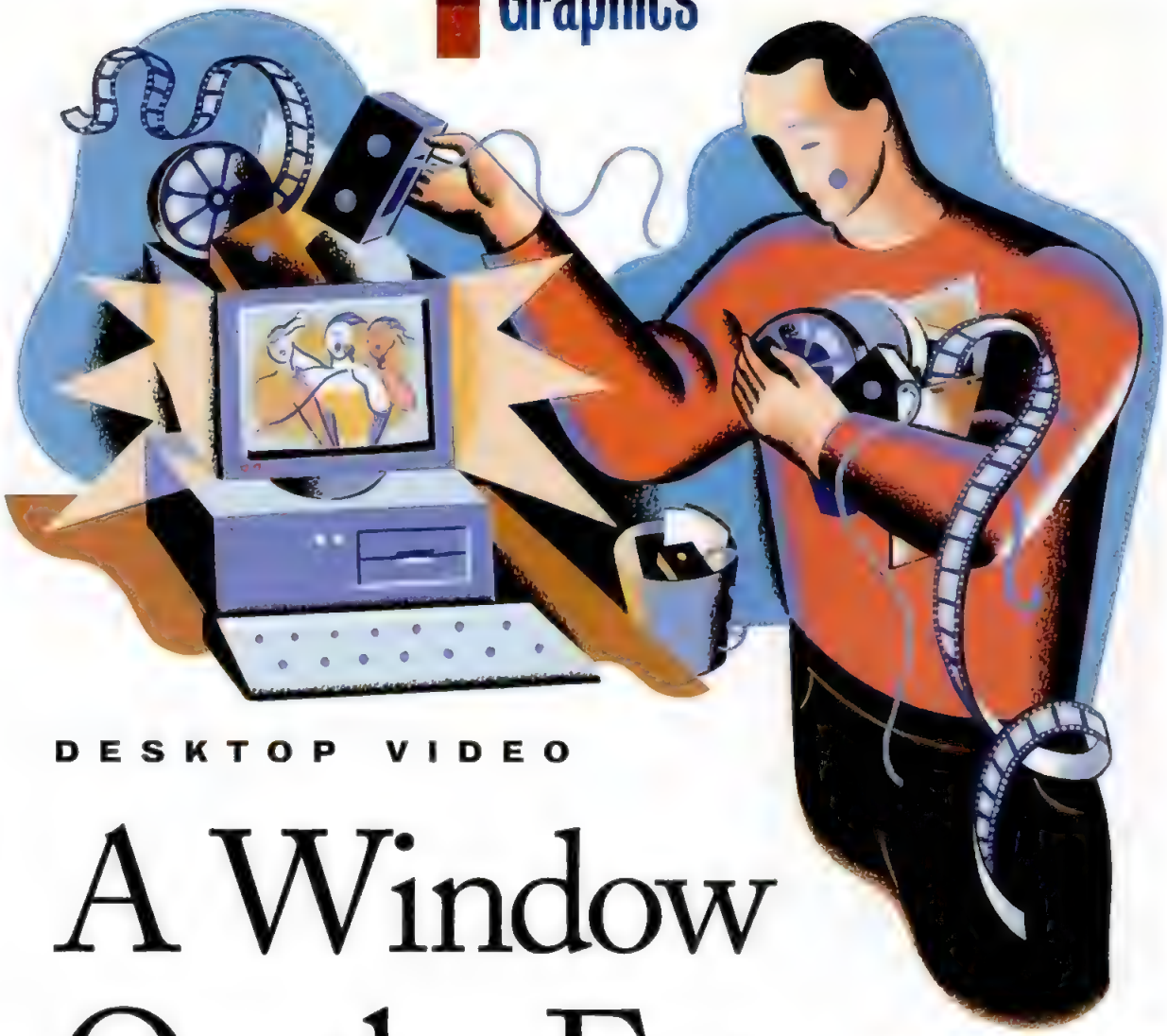


DESKTOP VIDEO

A Window On the Future

by Lori Grunin

As with any emerging technology, the goal of desktop video (DTV)—to play digital video images on your desktop PC—is simple to define but tough to accomplish. At least for a reasonable cost, at an acceptable quality, and with the fewest headaches for the end user. Through Video for Windows (VFW) and Object Linking and Embedding (OLE), Microsoft attempts to meet these goals and universalize DTV on the PC.

Since the VFW player can act as an OLE server, you can use the player to embed video clips in documents, spreadsheets, and presentations, as long as the software used to create the documents is an OLE client.

DTV is at the center of the rapidly growing technology circus known as "multimedia." To implement multimedia support, most microcomputer-based operating environments—Micro-

If you want moving pictures to convey your message, this may be the answer to your prayers. Or the beginning of your nightmares.

Illustration by Dolores Fairman

Glossary of Terms: Desktop Video Defined

bandwidth The maximum throughput of a system.

codec Compressor/decompressor

data rate The maximum sustainable throughput for an I/O device

digitize To convert an analog signal into binary representation by encoding the state of that signal at frequent, successive moments in time

frame grabber A board that captures single frames from a video source.

full-motion video Analog video converted to a digital signal for display on a PC monitor.

genlocking A signal synchronization technique that is essential to the process of creating a stable signal when you are overlaying computer graphics with video.

interpolation A form of motion compensation in which a frame is constructed during decompression based upon the difference information between the original frame (which is determined during the compression process) and both its previous and subsequent key frames

intraframes The full frames preserved by a compressor when motion compensation is performed on a video. Also known as **key frames** and **reference frames.**

lossless compression Any scheme that compresses a file by simply rearranging or recoding the data in a more compact fashion

lossy compression Any scheme that compresses a file by throwing away any data that the compressor deems redundant or unnecessary

motion compensation Compressing across video frames by saving only the differences between them.

prediction A form of motion compensation in which a frame is constructed during decompression from the difference information between the original frame (determined during the compression process) and the preceding key frame.

real-time compression Capturing and compressing video in a single step before writing to disk.

scalability The ability of a codec to optimally adapt a video to the data rate of the playback system

spatial Actions that are performed on an individual frame

streaming data Any data with a time component, such as audio and video

temporal Actions that take place across frames.

soft Windows, OS/2 Presentation Manager, and QuickDraw/System 7, for example—use architectural paradigms that are similar to each other and that support peripherals in a similar way. Because the subject of DTV is so complex, this introductory report will focus primarily on using video under Microsoft Windows.

The environment vendor (Microsoft, in this case) provides an application programming interface (API) with additional access to some basic services, including application-independent multimedia metafile formats and audio-video synchronization tools. Hardware vendors write drivers to the MCI (media control interface), which sits between Windows and the API. Software vendors write directly to the API.

In order to enable video under Windows, you must purchase—or receive bundled with a DTV add-in board—Microsoft's VFW, software that includes an API and tools for capturing, editing, and playing video and waveform audio.

Microsoft will eventually include the tools and API offered by VFW in Windows in much the same way IBM includes Multimedia Presentation Manager (MMPM) in OS/2 2.0 and Apple includes QuickTime in System 7.0.

SURVEYING THE LANDSCAPE

The general category of DTV applications and devices actually encompasses a variety of product types, ranging from those that simply control analog video devices—such as laserdisk players—to products that process analog video signals to other products that *digitize* (or *capture*) the analog signals for PC-based editing and playback. How the device is used and supported by the operating environment depends upon what type of board it is.

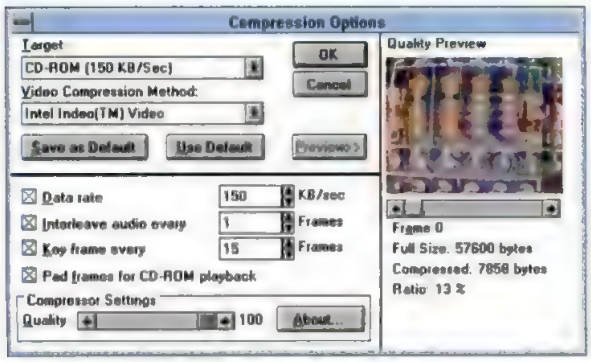
Even though we're primarily concerned with boards that allow you to capture and play back video, understanding the DTV landscape is essential if you're trying to decide whether your application merits sticking with analog technology, going completely digital, or using some combination of the two.

The common denominator among DTV products is that they accept video input; how the products are classified usually depends on how the PC processes that input. At one end of the spectrum are the "dumb" products—those that simply require or provide hardware that performs an analog-to-digital or digital-to-analog conversion on the incoming or outgoing signal without interacting with your PC's disk subsystem.

Three types of products fall into this category: TV tuner boards, VGA-to-NTSC (National Television Standard Committee) boards or boxes, and cuts-only PC-based video editing software. TV tuner boards, such as Hauppauge Computer Works' Win/TV, have proliferated in the past couple of years. These boards allow you to receive broadcast video and display it in a window on your monitor.

VGA-to-NTSC products, such as Magni Systems' VGA Producer Pro ($1,995), take the signal from your PC's graphics adapter and convert it to a composite signal (or Super VHS, or Hi-8—whatever your video standard is) so that you can record it on an analog medium such as a videocassette. If these VGA-to-NTSC products also offer genlock and overlay capabilities, they can combine your PC graphics with the video before sending it out to tape. (For more information, see "VGA-to-NTSC Boards: Let's

Our Contributors: LORI GRUNIN is a frequent contributor to and former associate editor of *PC Magazine.*



Video for Windows' built-in codecs allow you to choose the data rate of the playback device, how frequently to interleave the audio with the video, and the amount of spatial compression to perform.

Go to the Videotape" in the September 29, 1992 issue of *PC Magazine.*)

PC-based cuts-only video editors, on the other hand, are software tools that simply automate some of the tedious tasks associated with traditional A/B roll editing—the process of splicing and combining two or more videotapes. Software such as Gold Disk Inc.'s VideoDirector ($200) and Brown-Wagh's Studio Magic ($499.95) offer controls similar to those found on analog editing decks, and let you view, catalog, and tag video segments, and create *edit decision lists* (instructions for creating a final single videotape out of multiple source tapes).

VideoDirector ships with a Smart Cable that can be connected to your serial port and an industry-standard Control-L port on your video source; a third line runs to an infrared transmitter than interfaces to the infrared remote control receiver on the source. This is an unusual arrangement, however.

This type of software generally requires hardware support in the form of a board capable of performing NTSC-to-VGA conversion, known as a *full-motion video* or *video overlay* board. This type of board—such as Creative Labs' Video Blaster ($425), New Media Graphics Corp.'s Super VideoWindows ($995), or VideoLogic's DVA-4000 ($1,895; $1,995 with on-board SVGA)—allows you to display a live input video in a window anywhere on your screen. (In combination with a VGA-to-NTSC board, you can also add PC-generated titles to your final tape.)

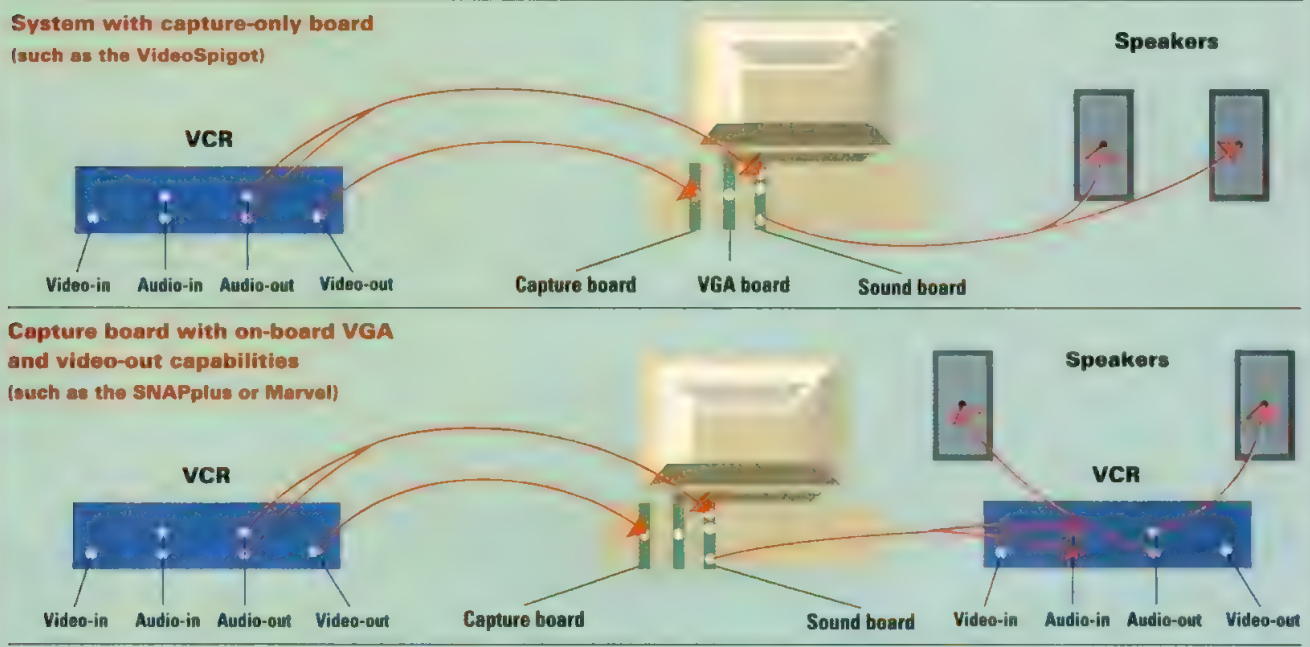
Those are the simplest functions that this class of boards performs. Full-motion videoboards have a range of capabilities, including the ability to control certain types of video hardware, most commonly laserdisk players, via serial communications. Some full-motion videoboards also allow you to add transition effects to the live video as it's displayed on your monitor. Keep in mind, though, that these boards are simply converting the signal and sending it to your display, bypassing the PC's graphics subsystem.

Fast Electronic U.S.'s Video Machine ($3,995) and Matrox Electronic Systems' Illuminator family of products ($1,595-$3,995) combine a sophisticated full-motion videoboard with cuts-only editing software. Unlike the full-motion boards alone, these hardware/software packages combine video windowing with VGA-to-NTSC conversion so that you can mix multiple input video and audio sources and add special effects.

These products are designed to replace traditional video post-production equipment, but not really improve upon it: They remain linear systems, always manipulating the video directly from the analog source.

Frame grabbers, such as Truevision's Targa family of products and Digital Vision's ComputerEyes/RT ($600), are

Sample DTV Systems



Individual systems vary according to the types of cables and connectors, but the capture and record paths generally follow the same pattern.

Where to Reach the Vendors

Following is an alphabetical list of the vendors mentioned in the accompanying article.

Aldus Corp. 411 First Ave. South, Seattle, WA 98104; 206-622-5500; fax, 206-343-4240

Asymetrix Corp. 110 110th Av. NE, # 700, Bellevue, WA 98004; 800-448-6543, 206-462-0501; fax, 206-455-3071

Brown-Wagh 160 Knowles Dr., Los Gatos, CA 95030; 800-451-0900, 408-378-3838; fax, 408-378-3577

Cardinal Technologies Inc. 1827 Freedom Rd., Lancaster, PA 17601; 717-293-3000; fax, 717-293-3055

C-Cube Microsystems Corp. 1778 McCarthy Blvd., Milpitas, CA 95035; 408-944-6300; fax, 408-944-6314

CEI P.O. Box 435, Osseo, MN 55369; 800-333-5234, 612-425-1167; fax, 612-424-9528

Compression Labs Inc. (CLI) 2860 Junction Av., San Jose, CA 95134-1900; 800-538-7542, 408-435-3000; fax, 408-922-5429

Creative Labs Inc. 1901 McCarthy Blvd., Milpitas, CA 95035; 800-998-5227, 408-428-6600; fax, 408-428-6611

Digital Vision Inc. 270 Bridge St., Dedham, MA 02026; 800-346-0090, 617-329-5400; fax, 617-329-6286

Fast Electronic U.S. Inc. Five Commonwealth Rd., Natick, MA 01760; 800-248-3278, 508-655-3278; fax, 508-650-0447

Gold Disk P.O. Box 789, Streetsville, Mississauga, Ontario, Canada L5M 2C2; 800-465-3375, 416-602-4000; fax, 416-602-4001

Hauppauge Computer Works Inc. 91 Cabot Court, Hauppauge, NY 11788; 800-443-6284, 516-434-1600; fax, 516-434-3198

Horizons Technology 3990 Ruffin Rd., San Diego, CA 92123; 800-831-9009, 619-292-8331; fax, 619-292-7107

IBM Corp. Old Orchard Rd., Armonk, NY 10504; 800-426-3333, 914-765-1900; fax, 800-426-4329

IEV International Inc. 3495 South 500 West, Salt Lake City, UT 84115; 800-438-6161, 801-263-6042; fax, 801-263-9980

Integrated Information Technology 2445 Mission College Blvd., Santa Clara, CA 95054; 800-832-0770, 408-727-1885; fax, 408-980-0432

Intel Corp. 2200 Mission College Blvd., P.O. Box 58119, Santa Clara, CA 95052; 800-538-3373, 408-765-8080; fax, 408-765-1821

Iterated Systems 5550-A Peachtree Pkwy., Norcross, GA 30092; 404-840-0310; fax, 404-840-0029

Logitech Inc. 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500; fax, 510-792-8901

Macromedia Inc. 600 Townsend St., Suite 310W, San Francisco, CA 94103; 800-288-4797, 415-442-0200; fax, 415-442-0190

Magni Systems 9500 SW Gemini Dr., Beaverton, OR 97005; 800-237-5964, 800-624-6465, 503-626-8400; fax, 503-626-6225

Mathematica Inc. 402 South Kentucky Ave., # 210, Lakeland, FL 33801; 800-852-6284, 813-682-1128; fax, 813-686-5969

Matrox Electronic Systems 1055 St. Régis Blvd., Dorval, Quebec, Canada; 514-685-2630; fax, 514-685-2853

Media Vision 3185 Laurelview Ct., Fremont, CA 94538; 800-845-5870, 510-770-8600; fax, 510-770-8648

Micrografx Inc. 1303 Arapaho, Richardson, TX 75081; 800-733-3729, 214-234-1769; fax, 214-994-6289

Microsoft Corp. One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-883-8101

New Media Graphics Corp. 780 Boston Rd., Billerica, MA 01821-5925; 800-288-2207, 508-663-0666; fax, 508-663-6678

Northern Telecom 200 Athens Way, Northern Telecom Plaza, Nashville, TN 37228; 800-667-8437, 615-734-4000; fax, 214-684-3807

Optibase Inc. 7800 Deering Ave., Canoga Park, CA 91304; 800-451-5101, 818-719-6566; fax, 818-712-0126

SuperMac 9130 SW Pioneer Ct., Suite B, Wilsonville, OR 97070; 508-682-8453; fax, 503-682-8722

TouchVision Systems 1800 Winnemac Ave., Chicago, IL 60640; 312-989-2160; fax, 312-989-2144

Truevision Inc. 7340 Shadeland Station, Indianapolis, IN 46256; 800-344-8783, 317-841-0332; fax, 317-576-7700

VideoLogic Inc. 245 First St., Cambridge, MA 02142; 617-494-0530; fax, 617-494-0534

Workstation Technologies Inc. 18010 Skypark Circle, # 155, Irvine, CA 92714; 714-250-8983; fax, 714-250-8969

Xing Technology Corp. 1540 West Branch St., Arroyo Grande, CA 93420; 805-473-0145; fax, 805-473-0147

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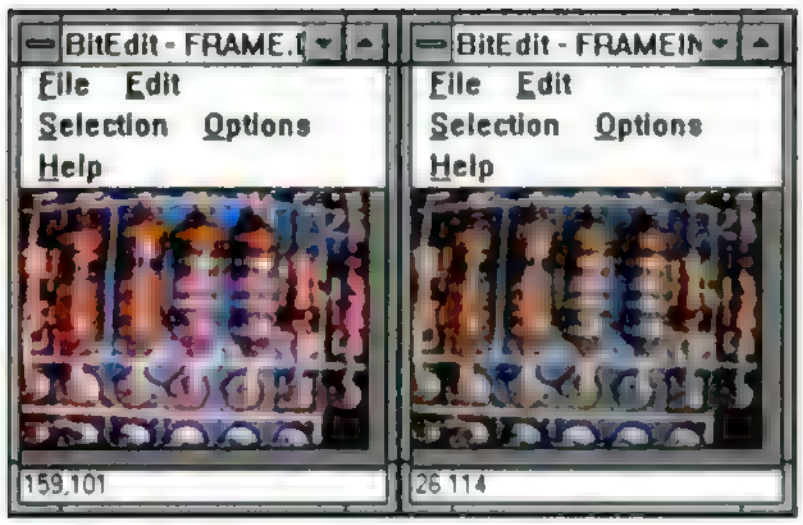


When you increase the amount of spatial compression with the Indeo codec, palette shifts occur. The lower the compression, the less severe the palette shifts appear.

of an older type of add-in board technology that lets you capture individual frames of video for editing with image-editing software such as Aldus's PhotoStyler ($795) or Micrografx's Picture Publisher ($495).

Still-video cameras, such as Logitech's FotoMan Digital Camera ($799), and slow-scan digitizers are philosophical, though not technological, offshoots of frame grabbers. Some video windowing boards are capable of capturing individual frames of video as well.

With all of these products, though, the only time you see motion is when you play the video from the analog source. Applications such as *digital video editing* (also known as *desktop post production*) and *desktop videoconferencing*, which utilize the PC's disk, video subsystems, and peripherals—are really what we mean when we talk about DTV.

For video editing especially, going digital can make a huge difference in productivity and system flexibility because it gives the editor the ability to work in a nonlinear fashion. You can retrieve the exact frame you want without constantly rewinding, and the penalties for experimentation—the time required and the degradation in the final video—are far less stiff than when working strictly with analog video. And desktop videoconferencing has been in our future since the idea of the videophone first gleamed in someone's eye.

SURVIVAL OF THE FITTEST

Despite its seeming inadequacies, there's a good reason that analog video has survived this long into the digital age: it's relatively *bandwidth*-efficient. For decades your TV has been pumping video at the equivalent of approximately 27 MBps (megabytes per second) into your living room; analogously, a videocassette or laserdisk can retrieve and display video at the same rate. Compare that with the 300 kilobytes per second (Kbps) sustained throughput that the average (non-SCSI) hard drive is capable of eking out or the 2.5 MBps that the ISA bus typically pumps through a graphics subsystem.

But while analog methods are very efficient for *streaming data*—data with a time component, such as audio and video—they're not very efficient in other ways. Accurate video editing is a time-consuming and expensive process with limited flexibility. Every change you make requires that you record onto another tape; each new recording degrades the quality of the video.

Analog video has traditionally been very difficult to integrate into our digital environment. Applications such as computer-based training and interactive kiosks have traditionally relied on laserdisk players hooked up via a video overlay board. Because of the high costs of mastering and duplicating the laserdisks and outfitting an installation with players, this solution has not been as widely adopted as it might have been.

Digitized video solves many of these problems. With the proper operating system support, it's quite easy to integrate digitized video into your digital world. It doesn't *require* any extra hardware for playback, and most importantly, you can edit a digitized video as many times as you like and there will be absolutely no degradation of the image quality.

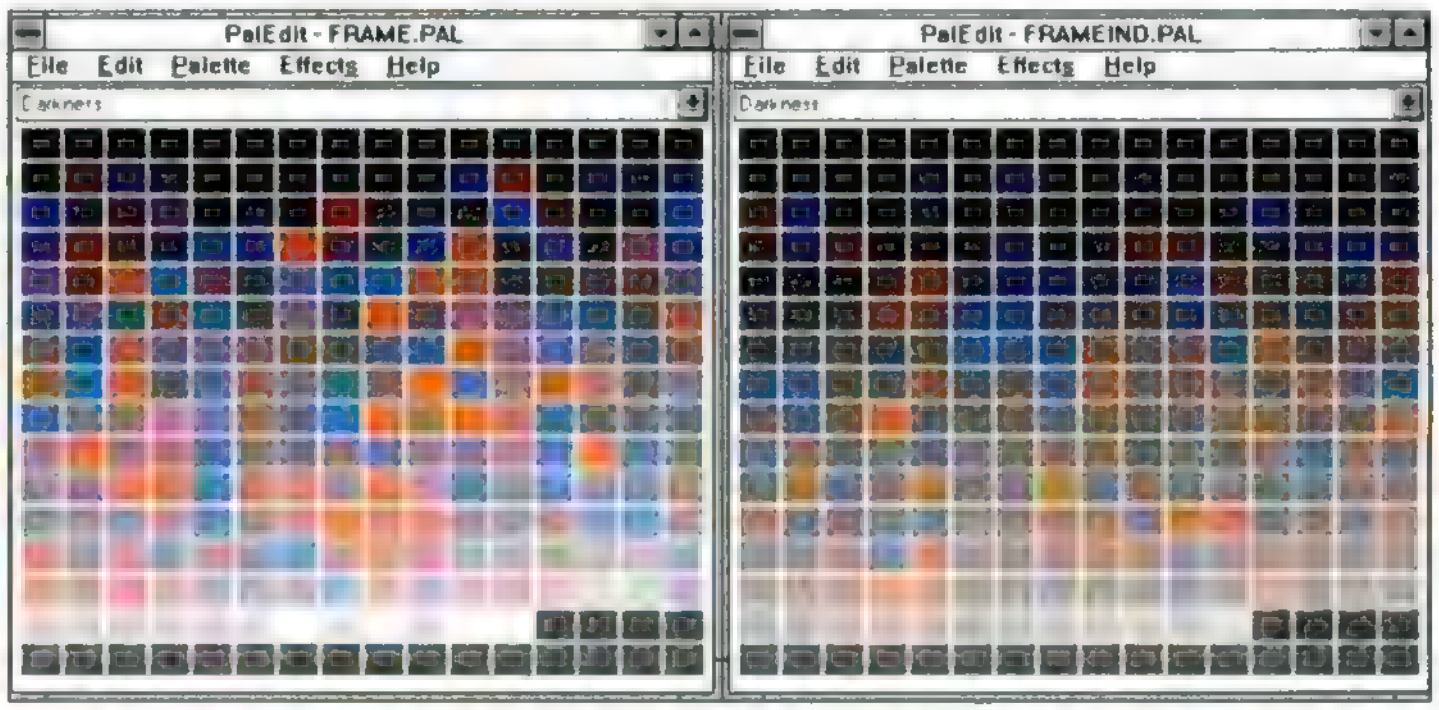
But while necessity is the mother of invention, its siblings are complexity and aggravation. Despite the many benefits of digitized video, there are still some major difficulties with its implementation. And the biggest difficulty is throughput, or how quickly your system can move information. A standard 30 frames per second (fps) video clip can translate to 18 MBps. That's a lot of data.

In the PC, both the disk subsystem and the video subsystem present the largest bottlenecks. Since it's extremely difficult to increase the *data rate* (another term for throughput), the industry has chosen instead to shrink the video down to fit through the pipe.

COMPRESSION TECHNIQUES

Traditional *lossless* file compression methods, such as run-length encoding, aren't quite up to the rigors of the task; they simply can't compact video enough. As a result, developers have had to resort to *lossy* compression methods that trade information for file size.

There are a number of methods for lossy compressing video, which combine *spatial* (for a given bitmap frame of video) and *temporal* (across a series of video frames) compression to obtain optimal file sizes for your target data rates. (For a discussion of the informational implications of lossy compression and digitized video artifacts, see the sidebar



The image on the left of this screenshot uses the optimal 236 colors at the lowest compression; on the right, it uses the Indeo codec's highest compression. Note the difference in palette shifts.

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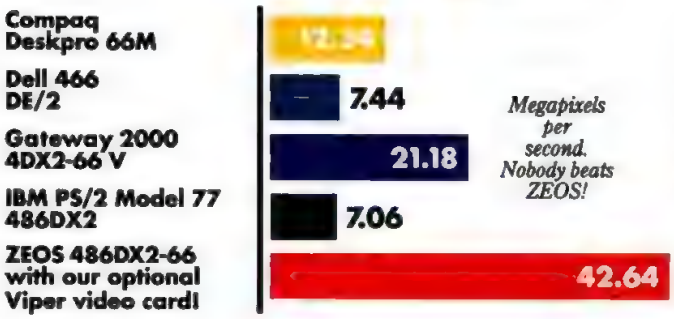

ZEOS "blew all competitors away—in some cases performing more than ten times as fast as competitors."
–PC Magazine, 1/26/93

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–*PC Magazine,* January 26, 1993

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–Jim Seymour, *PC Magazine* Feb. 9, 1993

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GbsSlipSheet-001

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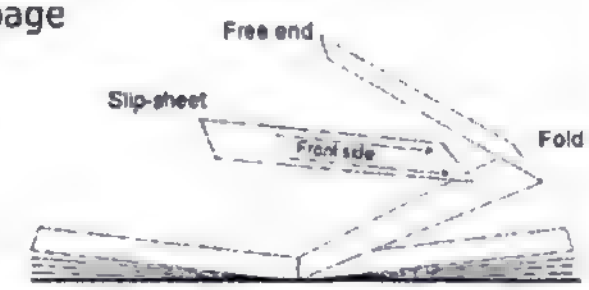
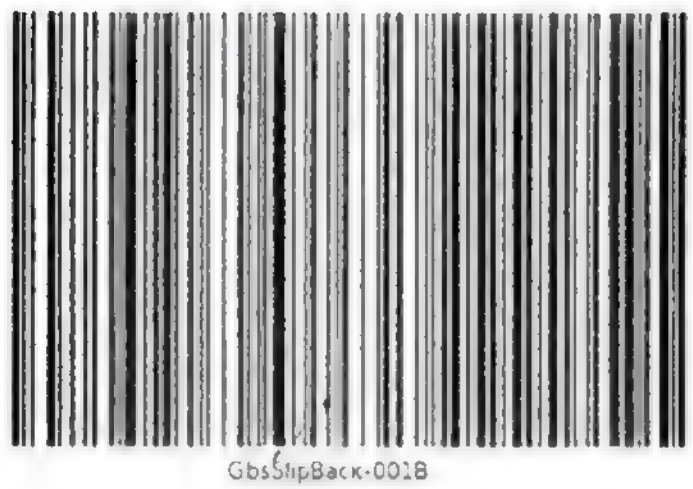
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





Back

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Inverted Back

1. Follow instructions on the other side

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Address _____ Apt _____ Monthly Gross Salary $ _____ Daytime Bus. Phone (____) _____

City _____ State _____ Zip _____ Previous Employer _____ From _____ To _____

Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____ Occupation _____

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VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

Joint Applicant's Name _____

Soc. Sec. No. _____ Date of Birth ___ ___ ___

Address _____ Apt _____

City _____ State _____ Zip _____

Home Phone (____) _____ Date of Residence (Mo./Yr.) _____

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"When It's Message vs. Medium.")

The first widely used method is to reduce the size of the video window; by dropping the size to 160-by-120 (the quarter-screen dimension suggested by VFW and QuickTime), for example, you immediately cut the required data rate of a 640-by-480 screen by three quarters. You can also shrink the video by reducing the number of colors in it. For instance, dropping from 16-bit color to dithered 8-bit color can halve the file size.

Combining those two methods can actually reduce an 18 MBps video clip to a seemingly slim 2.25 MBps. By adding a form of temporal compression, dropping the frame rate from the standard 30 fps to 15 fps, you can cut it in half again. (Color television actually has a frame rate of 29.97 fps, but it is commonly reported as 30 fps. Films use a frame rate of 24 fps.)

Unfortunately, that's still not quite lightweight enough. So, to further compress video files, vendors have developed special algorithms designed to drop picture information optimally. Unlike the

When It's Message vs. Medium

Discussions of the quality of digitized video tend to center around how imperfect the medium is when compared with television. But this shifts the focus to the entertainment value of the video—how well the clip engages the viewer—from whether the physical quality of the video—the look and sound—is good enough to serve your intended purpose.

Anything that degrades the playback of the video decreases the information content: That's the real quality issue. So successfully choosing when and how to use digitized clips means knowing when the message will appropriately overcome the drawbacks of the medium.

The bandwidth requirements of digitized motion video cause most of the problems associated with the technology, which generally manifest themselves as information loss. Desktop motion video products use a variety of techniques to minimize the amount of information sacrificed when meeting target data rates.

Usually, the first thing one notices when looking at or trying to use digitized motion video on a desktop PC is the size of the display window. Most playback algorithms are optimized for 160-by-120-pixel windows. That's $1/16$ the amount of information you could theoretically transmit if you used a full VGA screen. Of course, much of the information in a full VGA screen might be considered redundant.

So clips that show obvious change but have little detail will not suffer unduly. This also explains why desktop videoconferencing (DTVC) is such a rapidly growing segment of the DTV market despite relatively low quality; sufficient video quality requires, at most, the ability to discern changes in facial expression. Clear audio and proper audio-video synchronization are far more important than window size.

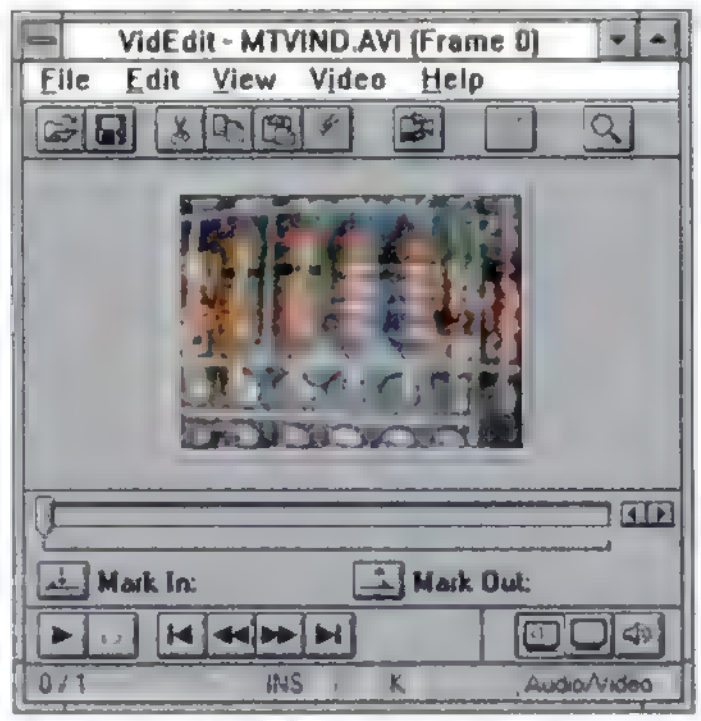
Dropping key frames during video capture means that entire sequences can get left out of your video. The result can be a radically different video. In this example, a key frame dropped from the top image results in an obviously missing transition visible in the bottom sequence.

previous methods, which are quite simple to implement, performing optimal software compression requires calculation and can be time-consuming.

Certain applications, most notably videoconferencing, require real-time compression. But because of the time-consuming computations it relies on, real-time video compression—compacting during capture—requires hardware support to accelerate the process; otherwise, important video frames play by while your PC is still grinding away compressing the first few frames.

At the other end of the spectrum, you can opt for *off-line* compression: Sending video out to a service that uses more sophisticated and even more time-consuming algorithms. The result? A more expensive process that yields a higher-quality product.

Many current DTV products have come to rely on a third alternative—performing software-only compression after capture—because it's relatively easy and inexpensive to implement.



VidEdit, which is one of the utilities that comes with the Video for Windows package, allows you to perform a number of basic editing tasks, such as retrieving frames, cataloging and bookmarking video segments.

CODEC CHAOS

In order for you to play a compressed video, your system needs to have a special driver that knows how to decompress it. Since that driver usually incorporates both compression and decompression routines, it's known as a *codec* (compressor/decompressor).

With VFW, codecs are installed via Windows' Control Panel. VFW itself ships with three codecs—an RLE codec, Microsoft Video 1, and Intel Indeo. JPEG and QuickTime codecs should be available in the near future. Third parties can also develop codecs for VFW, as SuperMac (SuperMatch VideoSpigot and SuperMatch YUV 4:2:2), and others have already done. In many cases, though not all, the codec requires hardware support and comes bundled with a DTV board, along with an MCI driver that tells Windows how to access the hardware. These codecs can support hardware acceleration for compression or decompression, or both, which allows them to capture and compress (or decompress) video in a single step.

But codecs are not as straightforward as they might be. A number of codecs don't plug into the environment at all, such as those included with New Media Graphics' Super Motion Compression and VideoLogic's MediaSpace. There are codecs for other platforms as well, such as IBM's PhotoMotion.

There are also off-line compressors that are aimed at the professional market, such as IBM's UltiMotion and Intel/Horizons Technology's PLV (Production Level Video). There are proprietary codecs aimed at videoconferencing, and there are nonproprietary codecs, such as the Motion Picture Experts Group (MPEG), that remain constantly in flux.

All in all, it's a codec Tower of Babel. But the glut of offerings isn't wholly the result of a lack of standards, as is usually the case with emerging technologies. Complicating the situation is the large variety of data rates that need to be addressed; it's difficult and inefficient to write a codec that will perform optimally playing video from a 150-Kbps CD-ROM drive on a 386SX *and* in a 486DX2-66 system with the graphics card and hard disk running on the local bus. In a market where the technology is under constant criticism for not being "good enough," it's quite conceivable that standardization needs to play second fiddle to optimization—temporarily.

ACCEPTABLE LOSSES?

Despite the variety, all codecs share a similar compression philosophy: They combine *intraframe* compression with *interframe* compression, referred to as *motion compensation*. Just as there is redundant information within any given frame (two adjacent blue pixels, for example), there is redundant information across frames: In a clip of a ball bouncing up and down, the pavement doesn't move.

FRAME-DROPPER

If individual frame detail is important, you can scale the video up to a larger window size. To compensate, however, the codec will either have to decrease the frame rate to preserve the data rate (a process called *frame-dropping*) or pause frequently.

Which method is more intrusive depends upon what the most important aspect of the motion portrayed on the video is. If you're primarily interested in direction—for example, showing the path of a projectile—then pausing is probably less problematic than frame-dropping. The missing frames may contain important path information, while pausing may just be irritating.

Most codecs will preserve the audio track's integrity during playback. While this makes sense for videoconferencing, if your clip has audio used for effect, you may want to use a lower sampling rate, drop the track, or introduce occasional silences to help preserve a continuous flow.

During compression, some codecs also offer the option of reducing the number of colors, generally to an 8-bit dithered palette. While this can greatly compress your video, it can obscure detail and distract the viewer.

This information-first approach is not meant to trivialize aesthetics, especially when using video clips in electronic presentations, games, or other attention-intensive applications. For these, the audience is demanding, and rightly so. Creating an amateurish video or one that will appear seriously degraded upon playback will do little to improve your professional image. So choose your clips carefully. □

Video Over the Network

When it comes to video, timing is everything. But while getting data to you quickly is certainly one of the important requirements of a network architecture, it's fourth on the list after getting your data to you at all, getting it to you error-free, and getting everyone else's data to them at the same time.

Several factors conspire against you getting data quickly. First, networks handle data in variable-sized packets. For every packet you receive from the server, the network software in your machine must determine whether the packet is meant for you, determine where the packet begins and ends, and then error-check it before finally sending it over your PC's frequently too-slow, too-small system bus.

More damaging to your chances is that most LANs can't prioritize data requests; each packet gets an equal slice of the server's time. There's no way to say "I need my data faster and in larger chunks than Bob does, so send three packets to me for every one you send him."

Sending data in packets and a lack of prioritization capabilities both present unnecessary overhead when dealing with streaming data (data that must flow continuously as opposed to data that can be sent in bursts) and can result in the video pausing, dropping frames, or both. Furthermore, if the video is interleaved with audio, the two can become unsynchronized.

And all of this assumes that you're the only one on the LAN; competing with your coworkers for sustained server access and space in that relatively tiny 16 megabit-per-second (Mbps) Token-Ring pipeline or 10Mbps Ethernet can bog you down even further.

Finally, transmitting your video over a wide area network (WAN) complicates matters even more; how much it does so depends upon your WAN architecture. For instance, most WANs have a relatively small bandwidth, ranging from 64Kbps per channel in the case of Integrated Services Digital Network (ISDN) to a seemingly generous 100Mbps in the case of Fiber Distributed Data Interface (FDDI), which can still be insufficient when split among multiple simultaneous requests for video. (For more information about various WAN architectures, see "Making the WAN Connection: Linking LANs," in the March 16, 1993 issue of *PC Magazine*.)

Although such a move raises the costs, you can give each client PC its own dedicated connection to a LAN adapter in the server. You'll eventually run out of slots, but you'll eliminate the network bottleneck.

BOOSTING BANDWIDTH

A variety of solutions, generally combining software and hardware modifications to LANs, have emerged to boost LAN-based video performance. ProtoComm Corp. (2 Neshaminy Interplex, Trevose, PA 19053; 215-245-2040, fax: 215-245-2049) offers a NetWare Loadable Module (NLM) that adds client/server video services to the network. Starlight Networks (444 Castro St., # 301, Mountain View, CA 94041; 415-967-2774, fax: 415-967-0686) offers StarWorks software, a video network protocol that runs on the same physical system as Novell, in effect creating a video server that coexists with a Novell server.

The most important of these services is the ability to arbitrate requests for streaming and nonstreaming data so that the streaming data can maintain a specified data rate. Reducing the error-checking and correction overhead on streaming data, while retaining it for nonstreaming data, for example, allows you to attain higher streaming throughput.

While adding these types of services can greatly improve performance, the vendors still suggest some hardware enhancements. One common alteration to an Ethernet network is to link workstations to the server via a high-speed hub combined with a switch, which can effectively give each user the full bandwidth of the network. (For more information about hubs, see "Empire Builders: 6 Enterprise Hubs," in the November 10, 1992, issue of *PC Magazine*.)

Remember, too, that the video residing on the server is (or should be) compressed. To optimize the throughput/quality trade-off, vendors also recommend equipping each workstation with a decompression board.

If you're in the mood for a more thorough network revamping, there are a couple of hardware-based solutions on the horizon. While they're not designed specifically for handling streaming data, they do boost the bandwidth of the LAN—and in some cases the WAN—so that in combination with the appropriate video services and protocols you'll get better video performance.

One such option is Fast Ethernet, a potential standard currently being considered by the Institute of Electrical and Electronics Engineers (IEEE); it is expected to attain throughputs of up to 100Mbps. Another is asynchronous transfer mode (ATM), which not only should provide greater bandwidth—up to 155Mbps—but since it uses small, uniformly sized cells to transport data packets, should be able to more quickly and efficiently handle streaming data.

While current network technology is still struggling with the demands placed on it by streaming data, some network-based applications, such as computer-based training, desktop videoconferencing, and video databases need the bandwidth now. The good news is it's available; the bad news is its neither cheap nor easy. □

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By analyzing the changes between the pixel maps of frame 1 and frame 2, the compressor discards any pixels that remain constant, such as those that describe the ground; during decompression, the codec can then rebuild frame 2 using just the difference information and frame 1.

Here, frame 1 serves as a *key frame,* a frame that has not been temporally compressed. This type of motion compensation is known as *prediction.*

Alternatively, the compressor may also save the differences between frames 2 and 3, then combine the 1–2 differences with the 2–3 differences and the key frames to rebuild frame 2. This method is known as *interpolation,* or *forward and backward prediction.*

Using interpolation is a more time-consuming method for compression and decompression than is prediction. Thus, applications that require real-time compression and decompression and have low bandwidth tend to stick with predictive algorithms—such as the Px64 standard scheme used in videoconferencing.

Higher-quality, off-line systems have the time to use interpolation and to experiment with varying pixel block sizes to improve motion compensation.

Higher-quality, off-line systems such as Horizons Technology's PLV, on the other hand, have the time to use interpolation and to experiment with varying pixel block sizes to improve motion compensation. Using PLV, however, requires that you send your analog tape to Horizons Technology. This is a costly approach, however, since billing is by the amount of video, in seconds, you're having compressed.

But these are not the only compression options. Key frames can be compressed as well, using standard lossy techniques. The most commonly used of these is the DCT (discrete cosine transform), the same method upon which the ISO-standard Joint Photographic Experts Group (JPEG) algorithm is based. Essentially, a DCT-based algorithm throws out redundant pixel data and analyzes the frequency of the color data to discard the data that's least important visually.

Still other codecs, such as Indeo, use vector quantization to achieve intraframe compression. This method relies less on discarding high-frequency color data than does the DCT method.

Not all codecs use motion compensation. New Media Graphics' SuperMotion Compression and VideoLogic's MediaSpace use C-Cube Microsystems' CL550 JPEG chip to capture and compress 30 fps video with 30 key frames.

And for some applications, using motion compensation yields unacceptable results. In video editing, for example, you need to preserve as much information as possible; if you deleted a key

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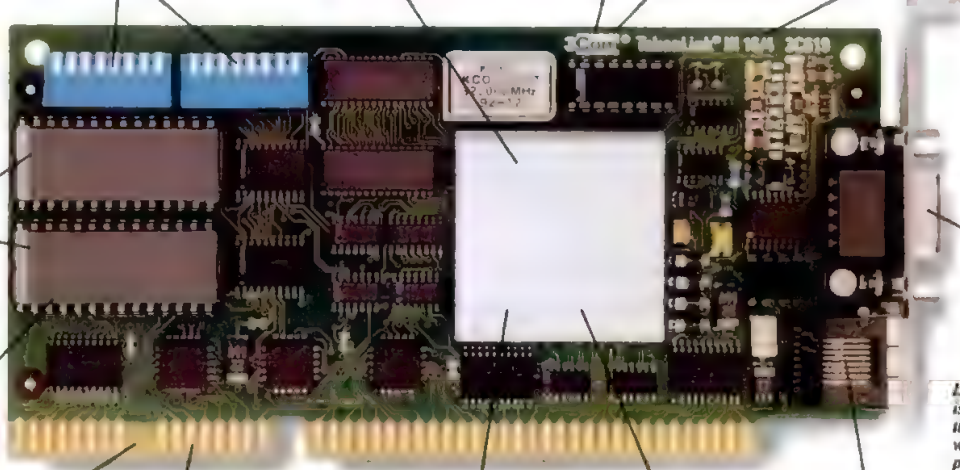

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frame from your bouncing ball sequence, your frame prediction might become unpredictable. Therefore it's always a good policy to work on the largest, most data-filled clips you can, and do the compression after you've finished editing.

SCALING THE HEIGHTS

It doesn't matter how good the compression scheme is if the video doesn't look good when you play it back. One important codec characteristic that can help you obtain the best possible playback results, regardless of the playback platform, is *scalability*. If you have a plodding old 386SX, scalability lets your codec know to play a video in a smaller window, or at a lower frame rate than it would on your neighbor's speedy new 486DX2/66.

Scalable codecs are also responsible for managing the interleaved audio and video streams so that the decompressor will drop frames in order to keep the audio playback smooth. This is because you're far more likely to notice dropped words than dropped frames.

But even scalable codecs can't make a clip look better. A 15 fps clip has at most 15 key frames per second of video; running the clip at 30 fps can make it faster, but will not improve the quality of the interframes. The scalable codec can run the video in a larger window, but the individual frames will still be pixellated (the mosaic-like effect you get when zooming in on a bitmap).

One codec characteristic that can help you obtain the best playback results, regardless of the playback platform, is scalability.

Iterated Systems, which developed the Fractal Transform Compression technology, is using that technology to compress motion video. In preliminary demonstrations, the technology's unique ability to scale images upward with no loss of detail yields better-than-acceptable results for full-screen video playback. The first products to use this technology should be available by the end of this year.

NOT CREATED EQUAL

Numerous variables affect the desirability of using one codec over another. Generally, the codec developer aims for certain ranges of data rates and makes compromises to reach that goal. Regardless of the codec used, the format of a VFW file is always AVI (Audio/Video Interleaved).

The VFW RLE codec, for example, was designed to be used on the base-level MPC machine, a 386SX with an 8-bit display and a 150Kbps CD-ROM drive. Since *each frame* of an RLE video must meet the target data rate, the codec requires tighter intraframe compression than you might need if you could spread the data rate out over several frames. But the codec must also be able to compress

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and decompress quickly on a relatively underpowered system.

The only way to satisfy all these requirements—and maintain acceptable video quality—is to set limitations on the kind of videos you should reasonably try to use with it. Thus, the RLE codec, which supports a maximum 15 fps frame rate in 8-bit color, is suggested for videos with very simple images or with little temporal change. Animation and talking heads fall into this domain.

In order to facilitate the best 8-bit color palette, VFW can analyze a clip of video and find the optimal 236 colors (20 of the 256 color palette are reserved for the Windows system).

You will be able to obtain higher-quality video using Indeo than using other codecs, but compression takes longer.

Microsoft's Video 1 codec (which emerged out of a synthesis of Microsoft's efforts and Media Vision's MotiVE codec technology) is the most general-purpose codec included with VFW. Although it's currently a software-only codec, Microsoft has released the source code to manufacturers for the development of hardware support.

Media Vision should have shipped the first of these products, a $40 two-chip set designed to go on the motherboard of 386- and 486-based PCs, by the time you read this. This chip set will allow users to perform real-time capture at 15 fps in both 15- and 16-bit color depths at a maximum resolution of 640 by 480 and will accelerate Video 1 compression and decompression.

Since this chip set requires relatively little external silicon support—the chips talk directly to the system bus, an NTSC-to-VGA encoder, and DRAM—the company hopes that it will bring DTV costs down.

Unlike the other codecs offered by Microsoft and third parties, the Video 1 codec allows you to select temporal compression quality (on a scale of 0 to .75) in addition to your desired spatial compression quality (which you can specify on a scale of 0 to 100).

In informal tests run at its default settings, the Video 1 codec compressed a 12MB video (with no audio) to 5.3MB; the playback quality was smooth but the video itself was of poor quality, with a lot of distortion and pixellation. Adjusting the temporal and spatial quality settings and key frame interval yielded much smaller files, but bad video quality.

The third codec that ships with VFW, Intel's Indeo, is based on its DVI technology. DVI has traditionally been hardware-based, so it's optimized for more powerful environments with data transfer rates ranging from 75Kbps to 300Kbps. It's a 24-bit technology that supports software-only compression and playback on 486-based systems, and hardware-assisted compression and playback on all other systems.

You can obtain a higher-quality video using Indeo than using the other codecs, but compression takes longer. Indeo compressed our 12MB file to 5.2MB, but with much better results than that of Video 1. On playback, the motion quality was acceptable and the image resolution fairly good.

Many desktop video production systems, such as TouchVision Systems' D/Vision and D/Vision-Pro ($495 and $3,950, respectively), use DVI because of its relatively high quality and its hardware-assisted ability to perform real-time compression.

But the price you pay is higher cost. Not only must you spring for the board—DVI boards such as the ActionMedia II from Intel will run you $1,395—but performing real-time 30 fps capture requires the fastest disk I/O technology available. For instance, D/Vision requires a SCSI hard drive using an Adaptec AHA-1542B controller.

Another traditionally hardware-based family of codecs comprises the three versions of MPEG. Although the initial specification for MPEG was targeted at the lower data rates associated with the PC, MPEG II and III are designed to create broadcast-quality compressed videos from TV and HDTV standard image sizes, respectively.

Given the ceaseless evolution of the specification, the broadcast-centricity of the parties involved, and the high cost of the supporting hardware—C-Cube's CL450 decompression chip runs about $200 in volume quantities, and Optibase's MPG-1000 codec board runs $5,000—it's little wonder that MPEG hasn't caught on in the PC market yet.

Software-only MPEG playback has been in the works for a while, though. One such product, Xing Scalable MPEG for Windows ($295) from Xing Technology Corp., lets you decompress and edit MPEG videos.

APPLES, ORANGES, AND KIWIS

Unfortunately, the hardware that allows you to digitize motion video—as opposed to the still video that frame grabbers capture—goes by many names. In many cases you can find yourself not only comparing apples to oranges, but staring blankly at an entire fruit basket.

Among the products that we looked at, only Cardinal Technologies calls its SNAPplus a "desktop video adapter." CEI dubs its Video Clipper a "motion video capture board," IEV International calls its ProMotion a "multimedia engine," Matrox Electronic Systems refers to its Marvel as a "multimedia controller," New Media Graphics calls its SuperMotion Compression a "compression/decompression board," SuperMac refers to its VideoSpigot for Windows as a "digital-video frame grabber," and VideoLogic calls its MediaSpace a "video and audio compression/decompression system." What they have in common is that all of them digitize motion video.

If it weren't for the existence of full-motion video boards and frame grabbers, this disparate nomenclature wouldn't be a problem. But they do exist, and ensuring that you get the board you need means paying careful attention to the features listed on the packaging.

TRANSLUCENT OPERATION

Once you have selected the proper board to use, you may still find yourself baffled. Despite the inroads that desktop video has made into the PC environment over the past years, the fundamental incom-

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Desktop Video Comparison Chart

	Pro Movie	Video Blaster
30 Frames Per Second	Yes	No
System RAM Limitations	No	Yes
DOS and MAC Player	Yes	No
AVI QuickTime Converter	Yes	No
S-Video	Yes	No
32,768 Colors	Yes	No
Feature Connector Required	No	Yes
Price	<$395	$495

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patibility between the analog and digital worlds means that the end user still needs to understand too much about video for DTV to be transparent enough to start flowing heavily into the mainstream.

In the simplest of all possible scenarios, in which you're a software-only, playback-only user, the transparency problem is more a result of problems with distributing documents with OLE-embedded clips. Size is one drawback; for instance, embedding a 2.5MB video clip in a 75K Word for Windows document increases the file size to 210K.

On the other hand, the OLE distribution scheme is generally no more difficult to use than traditional playback scenarios, such as a computer-based training application with laserdisk support. And while the quality isn't up to that of full-motion, pass-through video, digital playback can be an enabling technology for low-budget installations.

Authoring digitized video on the PC, however, is another story altogether. Even if you are not doing single-step capture and compression, the throughput of your hard disk subsystem can be crucial. While most of the capture board vendors don't require you to have a certain type of hard disk or controller, Microsoft does recommend that you defragment your hard disk before setting aside space for the file to which it will be writing the capture video, and also that this file be placed as close to the inside of the disk as possible. (Some defragmentation utilities allow you to specify where certain types of files are placed, based upon the relative frequency with which they are modified.)

This is no trivial recommendation. Without using this process, you can end up with most of the frames you're trying to capture dropped because the constant movement of the drive head seeking discontiguous clusters to fill up can really decrease your overall throughput. In one case, we actually ended up with an effective frame capture rate of 4 fps. Large numbers of dropped frames can also be the result of an interrupt conflict in your system.

The current selection of motion capture products runs the gamut when it comes to ease of setup and operation. The lower-priced boards tend to be easier to set up for video capture—they don't offer many options or the ability to input multiple video sources—and generally require a second board for audio capture. They also tend to max out at about 15 fps for video capture. The more expensive boards give you more options for video and audio captures, and a higher capture rate, but don't forget that the more options they offer, the more time you'll need for setup and operation.

The current selection of motion capture products runs the gamut when it comes to ease of setup and operation.

TURN ON THE SPIGOT

Along with Creative Labs, SuperMac was one of the first companies to support VFW with hardware—unsurprising in light of the active role the company plays in Macintosh-based DTV. Its VideoSpigot for Windows ($499), available from Creative Labs, is one of the simplest motion-video capture solutions to install and use.

That's probably because it's one of the least feature-rich. Although it comes with an extensive array of bundled software, including Video for Windows and a trio from Asymetrix—MediaBlitz, Multimedia Toolbook, and Multimedia Make Your Point—it doesn't support any sort of audio input. It does support capture of up to 30 fps, depending upon your system and window size, as well as the requisite video overlay capability, however.

VideoSpigot and the Media Vision ProMovie Spectrum ($349), which was not shipped in time for us to look at it for this story, are the first in a new breed of inexpensive DTV products hoping to target mass-market consumers.

Their relatively low prices can be partly attributed to the reasonably priced NTSC-to-VGA encoder chips available from myriad companies, including Philips and Chips & Technologies, combined with a no-frills feature set (for instance, they rely on pass-through VGA and don't accelerate decompression).

VideoSpigot is currently the only VFW product that comes with a proprietary codec: In fact, it comes with two. The YUV 4:2:2 is the equivalent of a straight, 24-bit, full-frame digitizer with no compression. The VideoSpigot codec, on the other hand, allows you to obtain higher-quality video than with the Video 1 codec, but at the expense of a lower compression ratio and slower compression. For example, the VideoSpigot compressor cut a 22.5MB file captured using YUV 4:2:2 in half, taking about 30 minutes in the process. Both of these codecs are supported through the MCI driver.

The codecs do not require the hardware for compression. And unlike the Microsoft codecs, the VideoSpigot compressor does not allow you to specify the target data rate or the interval between key frames.

For the same $499 as the VideoSpigot, Creative Labs' VideoBlaster gives you slightly more features, but slightly lower quality. The VideoBlaster uses pass-through VGA and comes with a number of applications—VFW, Macromedia's Action!, and Mathematica's Tempra for DOS.

But it's a much more limited solution. For instance, while the VideoSpigot accepts both S-Video and composite sources, the VideoBlaster accepts only composite video. Nor does the VideoBlaster provide its own codec. It does, however, support audio input.

DEEP ROOTS

New Media Graphics and VideoLogic have been following similar courses with their full-motion video products for many years, so it's unsurprising that their entries into the motion capture market are strikingly similar.

Both the Super Motion Compression and the MediaSpace use C-Cube JPEG chips on add-in boards that connect to the companies' respective video overlay boards, Super VideoWindows and DVA-4000; both also require a separate VGA card. At around $3,000 for the full system—a chunk of which goes to pay for the myriad cables they ship with the products in order to connect all the pieces—

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these are clearly not low-end solutions. Nor are they even complete DTV solutions, since JPEG is an image-only file format that can't interleave audio.

On the other hand, they both come with full-blown, painstakingly documented development APIs for users who need to integrate video into custom applications—something for which most of the other products aren't intended.

Most of the high-profile desktop video products tend to be those oriented toward the somewhat mythical mass-market buyer.

Two other products, which are more video-editing oriented, are the Matrox Marvel ($995, or $1,496 with on-board VGA) and the Cardinal SNAPplus ($1,295). The Matrox is accompanied by an intimidating six-foot-plus, multi-headed cable. Sprouting from it are two audio line-in RCA connectors, two video line-in RCA connectors, a 15-pin VGA connector, two audio line-out RCA connectors, and a connector for a pair of speakers. Although the board is easy to install, we had a hard time getting it to capture at anything close to 15 fps.

While it doesn't ship with any third-party utilities, the Marvel does come with three home-grown applications: Video Presentation Plus, which lets you keep a live video window on your screen; Matrox Key Frame Editor, which lets you control and save the movement of a live video window around the screen, as well as add special effects to overlaid PC graphics; and WinSqueeze, which offers software-based JPEG compression.

The SNAPplus, on the other hand, was less complex to install, performed admirably at 15 fps capture, and was able to output to videotape. All input and output takes place via proprietary connectors, although it doesn't support audio; quite a few cables come with the product.

The SNAPplus ships with Mathematica's Tempra paint software and an interesting little utility called ReelTime, which lets you perform a 15 fps capture straight to a .FLI or .FLC animation file.

CAN WE TALK?

Vendors tend to pitch the idea of universal DTV with lures of video clips embedded in presentations, and most of the high-profile products tend to be those oriented toward the somewhat mythical mass-market buyer. But when people talk about enterprise-wide video, they're often referring to videoconferencing.

Videoconferencing applications can be broken down into two types: personal and group systems. Traditionally, because of the high price and complexity of the systems—they have generally run from $50,000 to $55,000—videoconferencing has been a group activity, taking place in meeting rooms equipped with dedicated equipment.

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targeted at the industry-standard Px64 QCIF (176-by-144) resolution. But companies such as Compression Labs use proprietary methods to improve video quality; sacrificing frame rate for a slightly larger image size, for instance.

That company recently announced the Eclipse series of products, which is based on Integrated Information Technology's Vision Processor, a programmable chip capable of accelerating JPEG, MPEG, and Px64 compression. The systems range in price from around $15,000 to $20,000; the lower prices were made possible by increasing integration throughout the system and by honing down its feature set and flexibility.

Along the same lines, technology advances have made desktop videoconferencing more feasible. Compared with group systems, personal systems have far less stringent requirements. For instance, a group system needs echo cancellation technology, while a personal system can get by with a speakerphone-type setup. A personal system can also make do with less-expensive cameras, since the camera need not have as broad a focal range. Similarly, those tiny on-screen windows demand a far lower data rate than the large image needed to project in front of a group.

A spokesman for Intel foresees codec data requirements dropping from 1MBps to under 100Kbps within the next year.

The codec board that was developed by Workstation Technologies, on which Northern Telecom's Visit personal videoconferencing product is based (prices range from $2,900 to $3,500) resolves the bandwidth problem by using gray scale instead of color, at the usual 15 fps. The system workstations are hooked together via a 56Kbps channel, using either a Switched 56 unit or an ISDN adapter.

THE MONTHS AHEAD

Improving PC technologies will go a long way toward boosting the feasibility of universal DTV; the quality of clips played on a local-bus 486-based PC is markedly better than that on its 386-based ISA predecessor. With the arrival of local-bus-based Pentium machines, with potential throughputs of 100MBps, we're sure to see an even further improvement in quality.

A spokesman for Intel foresees codec data rate requirements dropping from 1MBps to under 100Kbps within the next year, as well as improved screen sizes and frame rates for a given data rate.

It's almost universally agreed upon that prices are too high for mass adoption and quality is too low to make DTV a must-have technology for everyone. But whether you're waiting for prices to come down or quality to rise, it's clear that you won't have long to wait. □

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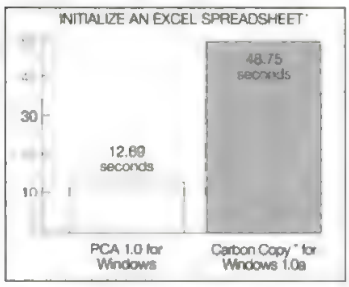

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Tracking TSRs

New DOS Trick

BY NEIL J. RUBENKING

TRACKING TSRs

Before I start certain applications, I must often load the TSR routine that a particular one may need; I accomplish this via a batch file. For example, since I normally don't use a mouse, I have to load the driver for mine in order to run Windows. Similarly, I invoke my word processor only after the *PC Magazine* utility ASC.COM (a TSR ASCII chart). When a program ends, I remove the related TSR using the pair of *PC Magazine* utilities INSTALL and REMOVE, in order to preserve memory. This approach fails though, when a utility has been put into upper memory via DOS 5.0, DR DOS 6.0, or one of the third-party memory managers.

In the course of a given day I might run the word processor a number of times, which can cause problems when the batch file attempts to load an ill-behaved driver that fails to determine whether it already exists. At best, this generates an error message that disrupts batch execution or wastes memory; at worst, the system runs out of RAM or locks up.

To circumvent the problem, my batch routine looks for a short flag file that it puts into a RAM drive before loading a corresponding TSR into high memory. If the file exists, the batch process knows that the TSR does too and can avoid accidentally reloading it, as Figure 1 illustrates. Since memory—and, as a result, RAM disks—are cleared by a reboot, TSRs will always load after a system start or restart. If more than one batch file needs the same TSR, I use the same flag file for each.

Dave Konkel
Galveston, Texas

TSRHERE.BAT
Partial Listing

```
...
if exist g:\mscmouse goto MouseLoaded
copy c:\menu\mscmouse g:
c:\mouse\mscmouse
:MouseLoaded
...
```

Figure 1: **Batch lines such as these can be used to load a TSR only if it hasn't been loaded already.**

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▶PC MAGAZINE: Some users don't have enough memory to spare for a RAM disk. Fortunately, though, this tip doesn't actually require one. Rather than copy a file to a RAM drive, I'd suggest creating a 0-byte file—which requires no memory and nothing on the hard disk beyond the 32 bytes for its directory entry. To incorporate this change into the listing in Figure 1, simply replace the copy line with `REM > G:mscmouse`. (You can create a 0-byte file a number of ways, but this is probably the simplest.)

Select a directory to hold the marker files, for example C:\BAT; and choose an otherwise unused extension, perhaps MRK. In your AUTOEXEC.BAT, you must include the line `DEL C:\BAT\*.MRK` (which you will modify, of course, if you use a different directory or extension). Now create 0-byte marker files as described above, using the specified directory instead of a RAM disk. For example, `REM > C:\BAT\MSCMOUSE.MRK` creates the marker file you'd look for with `IF EXIST C:\BAT\MSCMOUSE.MRK`.

VERIFYING MEMORY CONFIGURATION

Normally we don't pay too much attention to the loading of device drivers or to system configuration while our computers boot. If one of these operations doesn't function as planned, most of the time the result is a simple message that scrolls unnoticed off the screen.

To check that your system booted properly, first create a file called BASELINE.TST—the output of the MEM /C command at a point when you know the system configuration is correct to the last byte. Then insert these two lines as the very last lines in your AUTOEXEC.BAT:

```
MEM /C > MEM.TST
ECHO N | COMP MEM.TST BASELINE.TST
```

A memory report will be saved as the file MEM.TST, which will then be compared to the file BASELINE.TST. If the current configuration is also correct, the message "Files compare OK" will appear on the screen. Otherwise the message "Files are different sizes" or "Compare error at . . ." will appear, and you'll know that something went wrong during boot-up.

This is an effective method for detecting viruses, because a RAM-resident virus will always affect the memory configuration.

Helmut Beringer
Götzens/Tirol, Austria

MEMCOMP.BAT

Complete Listing

```
@ECHO OFF
REM MEMCOMP.BAT - tests memory configuration
IF NOT '%1'=='BASELINE' GOTO NotNuBase
IF EXIST C:\BAT\BASELINE.TST DEL C:\BAT\BASELINE.TST
:===== NotNuBase ===
IF EXIST C:\BAT\BASELINE.TST GOTO Compare
ECHO Creating C:\BAT\BASELINE.TST file...
MEM /C > C:\BAT\BASELINE.TST
GOTO End
:===== Compare =====
MEM /C > C:\BAT\MEM.TST
REM "e O" in next line is from message "Files compar_e O_K"
ECHO N | COMP C:\BAT\BASELINE.TST C:\BAT\MEM.TST | FIND "e O" > MEMCOMP1$.DAT
CLS
COPY MEMCOMP1$.DAT MEMCOMP2$.DAT > NUL
DEL MEMCOMP1$.DAT
IF NOT EXIST MEMCOMP2$.DAT GOTO Problem
DEL MEMCOMP2$.DAT
DEL C:\BAT\MEM.TST
ECHO ==============================
ECHO Memory configuration is correct.
ECHO ==============================
GOTO End
:===== Problem =====
ECHO ==========================================================
ECHO Memory configuration does NOT match stored configuration.
ECHO Review MEM.TST and BASELINE.TST to see what's different.
ECHO ==========================================================
ECHO.
ECHO Press a key to see a comparison of the two files.
PAUSE > NUL
FC C:\BAT\MEM.TST C:\BAT\BASELINE.TST /1 | MORE
:===== End =========
```

Figure 2: **MEMCOMP.BAT compares the contents of your system's memory against a known baseline listing and reports any significant differences.**

▶PC MAGAZINE: The MEM /C or MEM /CLASSIFY report, introduced in DOS 5.0, gives a listing of all loaded programs, drivers, and other memory blocks along with their sizes in decimal and hex, followed by the usual output of the MEM command. If any device driver or RAM-resident program is added, removed, or changed in your configuration, the MEM /C report will change. Hence comparing the output of MEM /C against a baseline report will tell you if any driver or TSR failed to load, or if a virus loaded itself in memory.

I implemented Mr. Beringer's suggestion as the batch file MEMCOMP.BAT shown in Figure 2. MEMCOMP assumes you keep your batch files in the directory C:\BAT. To store the report files elsewhere, change all occurrences of the string `C:\BAT` to the drive and directory of your choice. The first time you run MEMCOMP.BAT, the baseline data file doesn't exist yet, so MEMCOMP creates it. You can also tell MEMCOMP to create a new baseline data file by putting the word BASELINE (all uppercase) on the command line. Be sure that all of the drivers and TSRs you want to check are loaded and configured properly before that first time. Now simply add MEMCOMP as the last line in your AUTOEXEC.BAT file. Each time your computer boots up, it will check the contents of memory against the baseline. If the files differ, it will compare the files using the FC (file compare) command, also introduced with DOS 5.0.

The MEM command has two other switches that provide even more information about the system, /P or /PROGRAM and /D or /DEBUG. However, the report produced by either of these commands would contain too much information. With the /P or /D switch, MEM reports on not only the size of each program, driver, or other memory block, but its starting address as well. As soon as one item is added, removed, or changed, all items after it in the list will have a different starting address, and so will show up as changed themselves. The output of MEM with the /C switch has just the right amount of information. You can download MEMCOMP.BAT from PC MagNet as MEMCOM.BAT

NEW DOS TRICK

I often need to see what subdirectories I have in a directory. Previously I would have used the DIR /A:D to see directories only, but I believe I've found a shorter way. The command is

```
DIR ...
```

which also displays files that have no extensions. I use this under DOS 5.0.

Ajay Arora
Middletown, Connecticut

▶PC MAGAZINE: I rarely see a *new* DOS trick, but this one's a beaut! I tested it under DOS versions from 2.0 to 5.0, and it worked with all of them except the 3.*x* releases. In fact, DIR followed by two periods and any non-separator character—for example, `DIR ..x` — gives the same effect. The command `DIR ...` is equivalent to `DIR *.`, though, not to `DIR /A:D` as stated above.

The `DIR ...` or `DIR *.` commands only list files and directories that have no extensions, so the rare subdirectory with an extension will be ignored. Using DOS 5.0's DOSKEY utility, you can create a command that will quickly display all subdirectories but nothing else. Load DOSKEY (if you have upper memory blocks available, you'll save conventional memory by using the command `LOADHIGH DOSKEY`) and give the command

```
DOSKEY dird=DIR /A:D
```

That's it! When you enter DIRD at the DOS prompt, DOSKEY will expand it to DIR /A:D. You can add other switches, too—DIRD /P for example, which displays a screenful of subdirectories at a time. If you like the result, put the line that loads DOSKEY and the line that creates the DIRD macro into your AUTOEXEC.BAT. □

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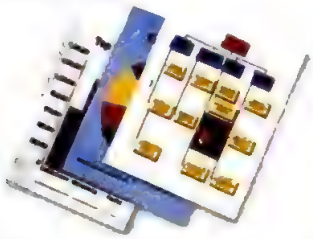

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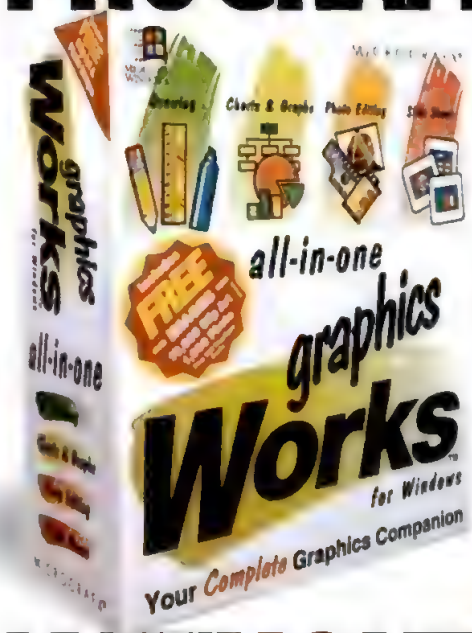

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EDITOR'S Home Office Computing PICK
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Unlocking the Mysteries Of CHKDSK

BY JEFF PROSISE

Make a list of the DOS commands that are the least well documented, and CHKDSK must go somewhere near the top of the list. That's really unfortunate, because CHKDSK is one of the most powerful commands that DOS has to offer. It's also the primary tool that DOS gives you to recover from crippling errors to a disk's logical structure—the part of the disk that contains information about files and where they are stored.

In this issue, we'll take a look at what CHKDSK is, what it does, and how it works. You'll learn how DOS stores files on-disk and how to use CHKDSK to repair the two most common types of disk errors: lost chains and cross-linked files. This information will help you understand what CHKDSK is doing when it goes to work repairing a damaged disk, and will better equip you to deal with other types of errors in the future.

THE FAT FILE SYSTEM To understand what CHKDSK does and how it works, you need a basic understanding of how DOS stores files on-disk. The key is understanding a data structure called the *FAT*, or *file allocation table*, which DOS uses to map out disk space allocation. The FAT is stored right on-disk, along with other information about the disk's logical structure and the files that it contains. Every DOS-formatted disk contains at least one FAT. The vast majority contain two. DOS uses the second FAT in case the first one contains errors.

DOS views the area of a disk where file data is stored as a series of sequentially numbered storage units called *clusters* or *allocation units*. An allocation unit is a group of one or more sectors. On floppy disks, allocation units are one sector long. On hard disks, the minimum cluster size is 4 sectors (2K). Disks are limited to slightly more than 65,500 clusters, so as the size of the logical volume increases, the cluster size increases too. For example, logical volumes ranging in size from 128MB to 256MB use 8 sectors per cluster, volumes from 256MB to 512MB in length use 16 sectors per cluster, and so on.

To keep track of which allocation units are used and which ones are free, DOS writes entries to the file allocation table. The FAT contains one entry for every allocation unit on the disk. A FAT entry of 0 means the allocation unit is unused; any other value means it contains part of a file or, if the value lies in a certain range, that the cluster contains a defective sector and must not be used for file storage.

Acquire an understanding of one of DOS's most useful commands, and in doing so learn how DOS keeps track of files on disks and how to repair common disk file ailments.

The FAT entries that belong to a given file are chained together in such a way that DOS can determine where the pieces of the file are stored by starting with the first allocation unit and walking its way through the chain of FAT entries. For example, if a file is stored in clusters 10, 11, and 12, then FAT entry number 10 contains the value 11; FAT entry number 11 contains the value 12; and FAT entry number 12 contains the value FFFh or FFFFh, which marks the end of the chain. FAT entries are either 12 or 16 bits in length, depending on the size of the logical volume in which the FAT is stored. If the disk contains fewer than 4,087 clusters, the 12-bit FAT will be used. So logical volumes less than about 16MB get 12-bit FATs, while logical volumes exceeding 16MB get 16-bit FATs.

FFFh marks the end of a chain in a 12-bit FAT, while FFFFh marks the end of a chain in a 16-bit FAT. A file's starting cluster number (10 in this example) is stored in a reserved field in the file's directory entry. For every file it creates on-disk, DOS creates a corresponding directory entry. In addition to the starting cluster number, the directory entry stores information such as the filename, the file size, and the time and date the file was created or last modified.

The beauty of the FAT file system is that files do not have to be stored in contiguous allocation units. For example, a file stored in allocation units 10, 11, and 12 could just as easily have been stored in 8, 16, and 20, since the FAT tells you what the next cluster is. This allows DOS to make efficient use of disk space. If files had to be stored in contiguous allocation units, DOS would have to take time out to compact the disk every time a file was created or deleted. This would slow performance to a crawl if a disk contained many files.

Figure 1 shows the FAT entries for a file that occupies ten allocation units in two separate parts of the disk. Allocation units 80h through 84h hold the first half of the file, and A0h through A4h contain the second half. Notice that the chain begins with the starting cluster number in the file's directory entry, and ends with the FFFFh marker in FAT entry A4h.

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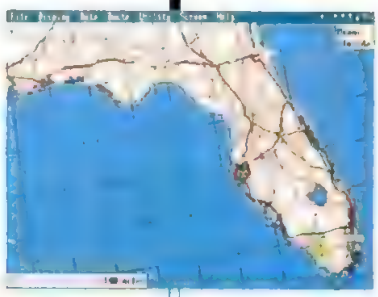

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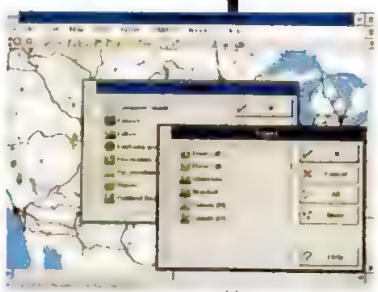

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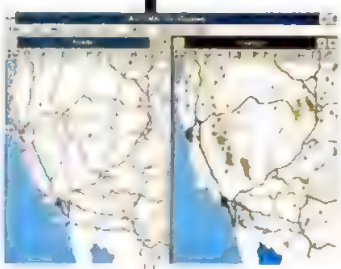

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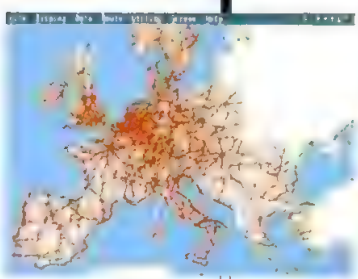

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We'll use this as a baseline for investigating common errors in a disk's logical structure, and for demonstrating how CHKDSK repairs those errors.

CHKDSK's mission in life is to scan the logical structure of a disk for errors and to report (and optionally fix) the errors that it finds. To do so, CHKDSK examines every directory entry it finds on a disk and traces the chain of FAT entries that correspond to it. Among other things, CHKDSK verifies that

- every allocation unit marked with a nonzero value in the FAT actually belongs to a file;
- no two chains converge on the same allocation unit;
- all the FAT entries for a file are valid (that is, that the chain of FAT entries does not contain a 0 or a number that is higher than the number of allocation units on the disk); and
- the file size information stored in a file's directory entry agrees with the number of allocation units allotted for the file.

Started without a /F (for Fix) switch, CHKDSK simply reports the errors it finds and does nothing to repair them. Started with the /F switch, CHKDSK will repair most common errors that occur in the FAT or elsewhere in the disk's logical structure—for example, in directory and subdirectory entries.

REPAIRING LOST ALLOCATION UNITS By far the most common error that CHKDSK reports is lost allocation units. The error message looks like this:

```
28 lost allocation units found
 in 3 chains.

   nnnn bytes disk space would be
   freed
```

This means that CHKDSK found 28 FAT entries that were marked as if they were in use, but that did not correspond to any file on the disk. So when CHKDSK traced through the FAT entries and the chain of clusters for every file on the disk, none of the chains led to these 28 allocation units. In this case, there are three groups of allocation units chained as if they belonged to three files, but there are no files whose directory entries point to the beginnings of these chains.

Figure 2 shows how one invalid entry written to the FAT could create a chain of lost allocation units. Originally, the FAT entry for allocation unit A1h contained A2h. However, the entry was inadvertently replaced with the value FFFFh, which marks the end of the chain. When CHKDSK traces the allocation chain for this file, it will stop at FAT entry A1h. Later, after it has scanned the other files on the disk, it will realize that allocation units A2h through A4h are orphaned and will report finding three lost allocation units in one chain.

How a File's Clusters Are Stored

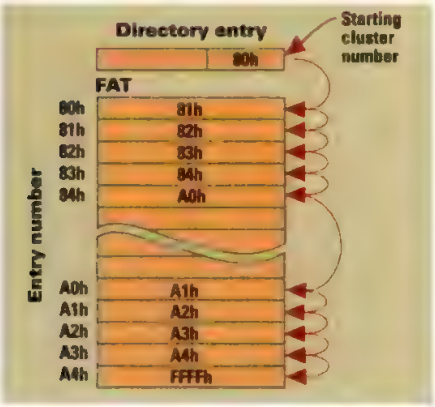

Figure 1: To map out the allocation units used to store a file, DOS places the starting cluster number in the file's directory entry and then fills the FAT entry corresponding to each cluster with the number of the next cluster in the chain. The final cluster is marked with FFFh or FFFFh.

Lost Allocation Units

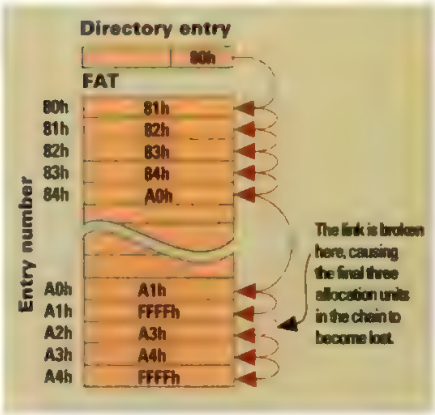

Figure 2: If one of a file's FAT entries is replaced with an end-of-chain marker, any clusters that occur after the marker are orphaned. CHKDSK calls these "lost allocation units."

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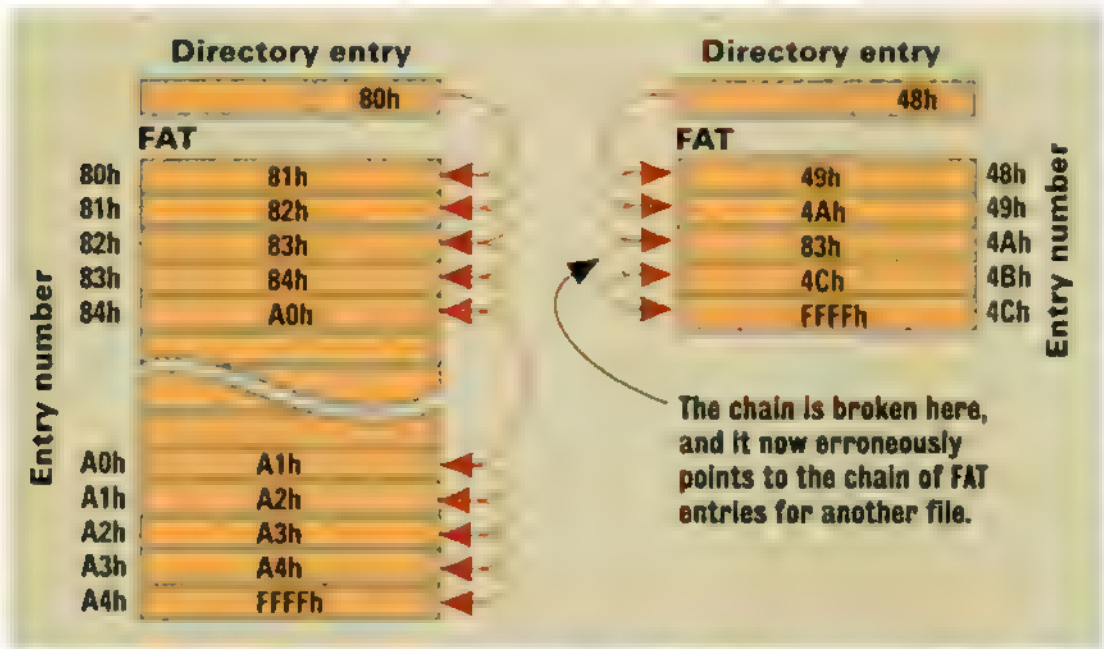

Figure 3: **Cross-linking occurs when two separate FAT chains converge. One of the files will be intact; the other will be corrupt.**

The most likely causes of lost allocation units (and cross-linked files) are using buggy programs, running programs (such as CHKDSK itself) that should not be run under Windows when there are files open, power glitches, and program crashes.

The simplest disk repair is to type

```
CHKDSK /F
```

and answer N (no) to CHKDSK's query "Convert lost chains to files (Y/N)?" CHKDSK will zero out the FAT entries, marking the clusters as available. The only problem is that the information contained in those allocation units will be lost. If you want to examine the information contained in the lost allocation units, answer Y (yes) to CHKDSK's prompt. CHKDSK will create a new directory entry in the disk's root directory for each chain and then associate the new directory entries with the lost chains.

Each lost chain will become a file with the name FILE*nnnn*.CHK in the disk's root directory, where *nnnn* is 0000, 0001, 0002, and so on. Use whatever tools you have at your disposal to view the .CHK files—the TYPE command, file browsers, and so on. Unless a lost chain once belonged to a file that contained plenty of recognizable text, it may be difficult to identify its original owner. If you can't determine where a .CHK file came from, delete it to save disk space.

REPAIRING CROSS-LINKED FILES The second most common error CHKDSK reports is cross-linked files. Figure 3 illustrates what happens when two files become cross-linked. Originally, FAT entry 4Ah held 4Bh, pointing to the next allocation unit for the file on the right. However, this value was overwritten with the value 83h, breaking the chain and coincidentally joining it to the chain of FAT entries for the file on the left. When CHKDSK is run on this disk, it will report the following information.

```
2 lost allocation units found
 in 1 chains.

  nnnn bytes disk space would be freed

C:\LETTERS\MAY92.DOC
   Is cross-linked on
 allocation unit 131
C:\LETTERS\JUN92.DOC
   Is cross-linked on
 allocation unit 131
```

The "2 lost allocation units" CHKDSK reported are allocation units 4Bh and 4Ch, which were orphaned when FAT entry 4Ah was changed.

Repairing this disk is a two-step process. First, make a copy of each file using another name. Second, run CHKDSK with a /F switch to eliminate the lost allocation units. To save the information that was lost from one of the cross-linked files, allow CHKDSK to convert the lost chain to a .CHK file. Then delete the originals and rename the copies to restore the original names. One of the files will be intact. The other will contain bogus information that it got from the other file when the cross-linking occurred.

If the file was a text or word processing file, you can repair it by calling it up in your text editor or word processor, deleting the text that came from the other file and replacing it with the text saved in the .CHK file.

LINKAGES BETWEEN ERRORS Frequently, error messages concerning lost allocation units and cross-linked files will be accompanied by other error messages. For example, if the FAT entry at A1h in Figure 1 were replaced with a 0, CHKDSK would report

```
C:\LETTERS\JUL92.DOC
 Has invalid allocation unit,
 file truncated
 3 lost allocation units found
 in 1 chains.
      nnnn bytes disk space
      would be freed
```

Despite what the message says, CHKDSK does not truncate the file unless it is started with a /F switch. If CHKDSK is run again with a /F switch, it mends the error by replacing the invalid FAT entry (the 0 in FAT entry A1h) with an end-of-chain marker, effectively truncating the file. Then it modifies the file length field in the directory entry so the length agrees with the count of allocation units, and frees the lost allocation units by zeroing the corresponding FAT entries or converting the lost chains to files. Running CHKDSK a third time should produce a clean bill of health for this disk.

CHKDSK can repair about 30 kinds of disk errors. Most of them are so esoteric that you'll never see them; if you do, then the disk's logical structure may be so badly scrambled that even CHKDSK will be unable to help. That's when you need a sophisticated disk repair utility such as the Norton Disk Doctor.

CHKDSK's greatest weakness is that it won't repair other common types of disk errors, such as those that result when the information stored in a disk's boot sector is damaged. For example, if the media descriptor byte (a byte in the disk's boot sector that identifies the type of disk—hard disk, 360K floppy disk, 720K floppy disk, and so on) is corrupted, DOS won't even recognize the disk. CHKDSK won't help, but the Norton Disk Doctor will recognize the problem and have you up and running again in a matter of seconds. The alternative is to reformat the disk or do some extremely difficult work with DEBUG. For most of us, neither of these is an acceptable choice. □

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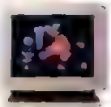

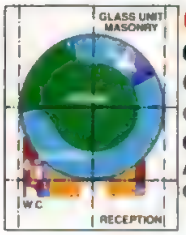

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REXX—IBM's Command Language for OS/2

BY DOUGLAS BOLING

The limitations of Microsoft's DOS batch file language have frustrated users since DOS 2.0. Finally—in OS/2 2.0—IBM has done something about it. Although OS/2 2.0's CMD.EXE continues built-in support for a DOS-like batch language, integrated into the new operating system is IBM's REXX command language interpreter. REXX is more than a simple batch language: It is a powerful, easy-to-use, high-level language.

REXX, which stands for Restructured Extended Executor, was developed for IBM's VM mainframe operating system by IBM guru Mike Cowlishaw, in Hursley, England. The popularity of REXX soon spread throughout the various IBM mainframe operating systems, and it has now become the standard command language for IBM's Systems Application Architecture. Support for REXX was built into OS/2 1.3, the best of the ill-fated 16-bit versions of OS/2.

Command languages have a more restricted purpose than that of other computer languages. In languages such as Pascal or Modula 2, the enforcement of strict rules helps the programmer not only to limit his mistakes, but also to achieve the best program design. When writing a command or batch file, however, the goal is not elegance, but simply getting the job done. The appeal of REXX is that it lets you accomplish your task without presuming that you want to write a "perfect" program.

In this Lab Notes, I'll discuss the basic aspects of REXX programming. In addition to explaining the standard branching, looping, and calling statements, I'll touch briefly on the other parts of REXX you'll need to write fully functional programs. While a language as powerful as REXX cannot be completely covered in one article, when you're done reading you should be able to write some fairly complex REXX programs.

Since REXX has maintained backward compatibility with its earlier versions, it often permits the same result to be achieved in any of several ways. In what follows I'll generally discuss only one way, but this should not be taken to imply that the examples I use are the only ways to get a particular job done.

Powerful yet easy to use, REXX—the command language built in to OS/2 2.0—gives you far more versatility than ever possible with DOS's batch file language.

PROGRAMMING IN REXX As with most computer languages, REXX is best learned by example. A good example with which to start is the classic "Hello World" program. The REXX version of this program goes as follows:

```
/*  My first REXX program  */
SAY Hello World
```

You should use an ASCII text editor to type in these two lines and save the file with the extension .CMD. Then, when you enter its name at the OS/2 command line, the program will execute, displaying the string, HELLO WORLD. Note that although I have capitalized the SAY statement for readability, it is not necessary to do so. (I'll continue to put REXX keywords in uppercase throughout the remainder of this article, however.)

This simple program demonstrates some key proprieties of a REXX program. The first line of the program is a comment enclosed by the delimiters /* and */. REXX ignores anything enclosed inside these delimiters. REXX comments may span multiple lines and may even be nested within another comment.

It is not just for the sake of good programming practice that this brief program has a comment as its first line. The first line of a REXX program *must* be a comment, since this is what tells OS/2 that the .CMD file is written in REXX instead of in the standard, DOS-like OS/2 command language. The first line comment requirement is also consistent with the mainframe versions of REXX, in which the comment also tells the operating system to use the REXX interpreter instead of its own mainframe command language.

The SAY statement does what the ECHO statement does in a DOS .BAT file, and more. In this program, SAY simply displays the string HELLO WORLD. If the program were instead written as

```
/*  My second REXX program   */
World = Doug
SAY Hello World
```

the output would be HELLO DOUG, for here the variable World has been assigned the value DOUG. Unlike the arcane DOS batch language, you don't have to use the environment for storing variables, so you don't need to use the SET statement and enclose variables in percent signs. Variables are set in REXX simply by using the equal sign, and

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```
(a)
/* Example of global scope  */
abc = 1
SAY abc def          /* ABC = 1, DEF = DEF  */
CALL changevar
SAY abc def          /* ABC = 4, DEF = 5    */
EXIT

changevar:
   SAY abc def       /* ABC = 1, DEF = DEF  */
   abc = 4
   def = 5
   SAY abc def       /* ABC = 4, DEF = 5    */
RETURN


(b)
/*  Example of the PROCEDURE statement */
abc = 1
SAY abc def          /* ABC = 1,   DEF = DEF  */
CALL changevar
SAY abc def          /* ABC = 1,   DEF = DEF  */
EXIT

changevar: PROCEDURE
   SAY abc def       /* ABC = ABC, DEF = DEF  */
   abc = 4
   def = 5
   SAY abc def       /* ABC = 4,   DEF = 5    */
RETURN


(c)
/*  Example of the EXPOSE statement */
abc = 1
SAY abc def          /* ABC = 1,   DEF = DEF  */
CALL changevar
SAY abc def          /* ABC = 4,   DEF = DEF  */
EXIT

changevar: PROCEDURE EXPOSE abc
   SAY abc def /* ABC = 1, DEF = DEF  */
   abc = 4
   def = 5
   SAY abc def       /* ABC = 4,   DEF = 5    */
RETURN
```

Figure 1: **REXX variables are usually global in scope (a), except when used in a PROCEDURE (b), where they become local. The EXPOSE statement (c) allows a listed variable in a PROCEDURE to be affected by code outside the procedure.**

they're used by placing the variable name where you want the value of that variable.

Notice that the output of the programs above is printed in uppercase. REXX translates every literal string that is not enclosed in quotes into uppercase. This irritating characteristic can be avoided by the liberal use of quotes. To make the output of the immediately previous program more user-friendly, you could write it thus:

```
/* A friendlier 2nd REXX program*/
World = 'Doug'
SAY 'Hello' World
```

This will produce the output, `Hello Doug`. The conversion to uppercase also makes variable names case-insensitive; the variable `World` is the same as `WORLD`.

The SAY statement displays numbers as easily as it does strings. The statement `SAY 2 + 3` will display the number 5. Variables, numbers, and strings can all be combined in one SAY statement, as shown in the following example:

```
/* SAY statement versatility */
answer = 5 + 3
SAY 'Five plus three is ' answer but
 five plus four is 5 + 4
```

Running this program will display the line

```
Five plus three is 8 BUT FIVE PLUS
 FOUR is 9
```

The first string is enclosed in quotes in this example, so it is not capitalized. The variable `answer` is replaced with the value 8, since the previous statement assigned it the result of 5 + 3. Since the second string, `but five plus four`, is not enclosed in quotes, REXX capitalizes it. Finally, SAY evaluates the expression 5 + 4 to the number 9 and prints it.

REXX processes each line in sequence until there are no more lines to process. If you want to stop the REXX interpreter from executing any more lines beyond a certain point in a program, you use the EXIT statement. In the next example, I have added an EXIT statement to insure the program terminates after the first SAY statement but before the second SAY.

```
/* Using the EXIT statement */
World = 'Doug'
SAY 'Hello' World
EXIT
SAY 'This line will not be
 executed!'
```

In this example, the EXIT statement serves only to prevent the second SAY instruction from being executed. In the more complex examples below, the main program will be followed by *subroutines* and *functions*. Without the EXIT command at the end of the main program, the interpreter would attempt to execute subroutine lines listed after the program itself had finished.

Asking the user for input is easy, though the name of the command is strange. The PULL statement returns a string from what REXX-speak calls the *standard input queue*—usually the keyboard. I'll discuss the whole queue concept later, but for now just think of the PULL statement as an oddly named INPUT statement. You can now make the original example a bit friendlier:

```
/* A personalized REXX program */
SAY 'What is your name?'
PULL name
SAY 'Hello' name
```

The PULL statement can handle

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more than just one variable. Each variable after the PULL instruction, with the exception of the last, is assigned a single word from the line entered by the user. The last variable is assigned the remainder of the line. For example, suppose the PULL statement were

```
PULL dog cat mouse
```

and the user entered the line,

```
'Now is the time for all good men'
```

The variable DOG would be assigned the word Now, CAT would be assigned is, and MOUSE would be assigned the time for all good men, which is the remainder of the line.

If the user enters fewer words than there are variables, the remaining variables are set to a string with no characters, that is, a *null string*. If the user entered 'Not Now' in response to the PULL statement above, DOG would be assigned Not, CAT would become now, and MOUSE would be a null string.

BRANCHING AND LOOPING As with any high-level language, REXX supports the standard branching and looping statements. The IF statement allows users to branch on a condition as, for example, in this code fragment

```
/*  Using the IF statement  */
IF hour > 6
THEN
  SAY 'Good Evening'
```

As would be expected, this program will print the line Good Evening if hour is greater than 6. An ELSE statement can be included and will be executed if the condition tests false. In the following example, Good afternoon is displayed if hour is before or equal to 6.

```
/*  An example of IF-THEN-ELSE */
IF hour > 6
THEN
  SAY 'Good Evening'
ELSE
  SAY 'Good Afternoon'
```

REXX allows you a fair amount of flexibility in positioning its statements. For example, the previous IF statement could have been written as

```
IF hour > 6 THEN SAY Good Evening'
ELSE SAY 'Good Afternoon'
```

On the other hand, if the statement were written

```
IF hour > 6 THEN  SAY 'Good Evening'
 ELSE SAY 'Good Afternoon'
```

and hour = 7, the output would be

```
Good Evening ELSE SAY 'Good
  Afternoon'
```

This odd result comes about because, unlike the THEN clause, the ELSE must be placed on a separate line. In this case, therefore, the REXX interpreter assumed anything past the SAY statement should simply be printed to the screen.

Fortunately, for the legion of C hackers who absolutely live to compress complex programs into as few lines as possible, there is a solution. REXX statements can be placed on the same line if they are separated by a semicolon. To restore the previous statement to its proper functionality, it can be written as a single line thus:

```
IF hour > Say 'Good Evening';
 ELSE Say 'Good Afternoon'
```

The ELSE statement binds itself with the most immediate IF statement that does not already have an ELSE statement. To insure that ELSE statements bind correctly, you can use the NOP (No OPeration) statement as a placeholder to fill in dummy ELSE statements, as needed. Note that simply using a semicolon on the line—as is often done in C programs—will not work in REXX. The following example shows how to nest the IF statements properly:

```
/* Nested IF statements  */
IF month = 12
THEN
   IF date = 25
   THEN
      SAY Merry Christmas'
   ELSE
      NOP
ELSE
   SAY 'It is not December yet'
```

Without the NOP statement, the last ELSE statement would be bound with the second IF statement.

When used alone, the THEN or ELSE statements can only execute a single line. If you want to apply them to more than one line, you must enclose the lines in a DO END block, as shown in the following example:

PUSH PSEUDOCODE

```
(a)
/* Using PUSH and PULL to save temp data */
PUSH TIME()
DO 1000
   /* Do something here 1000 times */
END
PULL starttime

SAY 'The start time was' starttime 'and the end time was' TIME() EXIT


(b)
/* Using PUSH to set a default answer */

Say 'Do you want to confirm the operation'
PULL confirm
if (confirm = NO)
THEN
   PUSH 'YES'

SAY 'Do you really want to do this?'
PULL answer
if (answer = 'YES')
DO
   /*  Do operation  */
END
EXIT
```

Figure 2: **In (a) above, the PUSH statement is used to store the time at which a process begins for later comparison. In (b), PUSH stores a default answer to a user confirmation request.**

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```
IF hour > 6
THEN DO
   SAY 'Good Evening'
   SAY 'Don't work too late!'
END
```

Looping is as simple as branching in REXX. In the following example the program will continue to loop while the variable answer is not equal to 5.

```
/*  A persistent program */
answer = 0
DO WHILE answer <> 5
   SAY  'What is 2 + 3 ?'
   PULL answer
END
```

The WHILE loop tests the condition and, if it is true, proceeds to execute the body of the loop. In this program, the loop will continue until the value 5 is returned.

The DO UNTIL statement can be used when the testing of the condition is to be performed after the body of the loop has been executed. The previous program could have been written as:

```
/* A persistent program, Take 2  */
DO UNTIL answer = 5
   SAY  'What is 2 + 3 ?'
   PULL answer
END
```

Notice that the initial ANSWER = 0 line can now be removed, since the body of the loop will be executed and the variable answer will be assigned a value before the condition is tested.

The LEAVE statement can be used to depart from a loop in midstride. Modifying the previous example to use the LEAVE statement makes the program a bit less stubborn.

```
/* A persistent program, Take 3 */
DO UNTIL answer = 5
   SAY  'What is 2 + 3 ?'
   PULL answer
   IF answer = QUIT
      THEN LEAVE
END
```

Note that the LEAVE statement can be used with any of the looping statements in REXX.

Repetitive looping can be performed by replacing the WHILE/UNTIL condition with a number. In the following example, the loop will execute 1,000 times.

```
/*  Ask for forgiveness  */
DO 1000
   SAY 'Pardon'
END
```

If you need to know the iteration count for the loop, the syntax can be expanded to look more like the FOR statements found in other high-level languages. The following loop prints the numbers 1 though 5 on the screen.

```
/*  Count to 5  */
DO i = 1 TO 5
   SAY  i
END
```

To modify the amount by which the loop variable is changed for each iteration, the BY keyword can be used as in the following loop:

```
/*  Countdown  */
DO i = 10 TO 0 BY -1
   SAY  i
END
SAY 'Blastoff!'
```

This short program will print the numbers 10 through 0 in decreasing order and will then print the string `Blastoff!`.

SUBROUTINES As would be expected of a high-level language, REXX can call subroutines. To call a routine, the keyword CALL is used, and equally appropriately, the keyword RETURN is used to return to the statement following the original CALL. In the following example, the forgiveness routine is called using the CALL statement.

```
/* Example using a subroutine  */
CALL forgiveness
SAY 'Am I now forgiven?'
  /* other code */
EXIT
forgiveness:
   DO 1000
      SAY 'Pardon'
    END
RETURN
```

As illustrated here, placing the forgiveness routine in a subroutine allows it to be executed with a single CALL statement. To return from the subroutine, the RETURN statement is used. When REXX encounters a RETURN, it returns to the line following the most recent CALL statement—in this case, to the SAY statement following the CALL.

This example also uses the EXIT statement, which terminates the REXX program. The EXIT is needed because without it REXX would continue to execute lines sequentially until it fell into the forgiveness routine.

Arguments can be passed to a subroutine by including them on the same line as the CALL statement. Multiple arguments to be passed are separated by commas. In the following example, the forgiveness routine has been changed so that the caller can modify the number of times forgiveness is requested as well as for whom forgiveness is asked. The subroutine accesses the passed parameters by using the ARG() function.

```
/*  A subroutine with parameters */
CALL forgiveness 10, 'me'
  /* other code */
EXIT
forgiveness:
   i = ARG(1)
   DO i
      SAY 'Pardon' ARG(2)
   END
RETURN
```

ARG() is a built-in function that returns the parameter specified in the argument to the function. ARG(1) returns the first parameter, ARG(2) the second, and so on. If ARG() is called without any parameters, it returns the number of parameters passed to the subroutine. In the preceding example, a call to ARG() with no parameters would return 2, since two parameters were passed to the forgiveness subroutine. If a subroutine is called with fewer parameters than the number passed to the ARG() function, ARG() returns a null.

The following example checks for the existence of a parameter before using it.

```
/* Parameter-checking subroutine */
CALL forgiveness 10, 'me'
  /* other code */
```

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```
EXIT
forgiveness:
   IF (ARG() < 2)
   THEN
      RETURN
   DO i
      SAY 'Pardon' ARG(2)
   END
RETURN
```

Like the parameters in subroutines, the command line parameters of a REXX program can be returned by using the ARG() function. If ARG() is called in the main body of the program (outside any subroutines), the parameters returned are taken from the command line. Just as %1 returns the first command line parameter in a DOS batch file, ARG(1) will return the first command line parameter of a REXX program. Called without any parameters in the main body of the program, ARG() returns the number of parameters on the command line.

FUNCTIONS REXX also supports user-defined functions. Although generally similar to subroutines, functions have a number of different properties: Calling a function does not require a CALL statement, parameters passed to the function must be enclosed in parentheses, and the function must return a value on the RETURN statement.

In the next example, the function DOUBLE returns the value passed, multiplied by 2. Although this is a trivial function, DOUBLE demonstrates the necessary properties of a REXX function.

```
/* Demonstration of a function  */
say DOUBLE(6)
EXIT
double:
i = ARG(1) * 2
RETURN i
```

Notice here that although the parameters are passed inside parentheses, they are still retrieved with the ARG() function. The RETURN statement is followed by the value to be returned. In addition to user-defined functions, REXX also has over 50 built-in functions, though their treatment must be deferred to another occasion.

One of the quirks of REXX is that function names must be *immediately* followed by the opening parenthesis; no intervening space is permitted. For example, when using the DOUBLE function, REXX interprets the lines `DOUBLE(1)` and `DOUBLE (1)` differently. In the first case, REXX treats the word as a call to the function DOUBLE and returns the result of the function. However, in the second case, `DOUBLE (1)`, REXX parses the DOUBLE as a variable name and separately parses the (1) as the value 1.

No discussion of subroutines and functions would be complete without discussing *scope*. Scope is the part of the program for which a variable is defined. In DOS batch files, all environment variables are global in scope, since they can be set and used anywhere in the batch file. REXX variables, too, are *generally* global, that is, retained throughout the program. In the program shown in Figure 1(a), for example, the variable ABC is modified in the subroutine, but it retains its new value after the return. The variable DEF is assigned in the subroutine, and it also retains its new value after the subroutine returns.

The PROCEDURE statement can be used to make variables private to a specific routine. In such a case, the PROCEDURE statement acts like a brick wall, separating the variables defined within the PROCEDURE statement from those defined outside it. Variables that are defined within the PROCEDURE statement are unrecognized beyond the point at which the next RETURN statement is executed. Thus, as shown in Figure 1(b), adding a PROCEDURE statement to the previous example localizes the variable. In this case, the PROCEDURE statement has been added at the start of the changevar routine. The variables in the routine will now be completely independent from the other parts of the program.

The variable-localizing effect of the PROCEDURE statement can be modified by using the EXPOSE keyword, as shown in Figure 1(c). As its name suggests, the EXPOSE instruction allows one or more listed variables to be "exposed" to the code outside the PROCEDURE instruction. In Figure 1(c), then, by adding the EXPOSE instruction to the previous example, the variable ABC is exposed in the routine changevar. The PROCEDURE statement now has an effect on ABC but still protects DEF.

THE QUEUE INTERFACE One of the more confusing parts of REXX is its handling of user input. As mentioned above, the statement used for asking users for input from their keyboards is PULL. While this seems a strange name for something that should be called ASK or INPUT, the name PULL does have some relation to reality, for REXX is designed so that programs can read data from an input queue.

Generically, the PULL command attempts to remove an item from the currently active REXX input queue. This is normally attached to the standard input device—the keyboard—so if nothing is in the queue, PULL waits for the user to enter data at the keyboard. By using PULL with its companion PUSH and QUEUE commands, however, the queue can be attached instead to an OS/2 interprocess data queue. This redirection is much more powerful than the old DOS redirection mechanism: REXX queues enable communication between two programs running at the same time.

The PUSH statement allows a REXX program to shove data into the queue in such a way that the pushed data will be returned at the next PULL statement. Data PUSHed into the queue is organized in a Last-In-First-Out (LIFO) manner. That is, the last thing pushed into the queue is the first thing pulled out.

In the next example, three PUSH instructions are used to place three strings in the input queue. The data is then removed by three successive PULL statements. Notice that the data is removed in reverse order due to the LIFO ordering of the PUSH statement.

```
/* Using PUSH and PULL */
PUSH 1
PUSH 2
PUSH 3
PULL first
PULL second
PULL third
SAY first second third 'Blastoff!'
```

Running this example will print the line, `3 2 1 Blastoff!`, since the numbers were removed in the reverse order from the way they were placed in the queue. Note that because there was

already data in the input queue, the PULL instructions did not wait for user input. Inclusion of a fourth PULL instruction would have caused the program to pause and wait for user keyboard input, since only three items were in the queue.

The QUEUE instruction also places data in the input queue, but in a First-In-First-Out order. In a FIFO system, the first item placed in the queue is the first item removed. If the above example had used the QUEUE instead of the PUSH instruction, the SAY statement would print `1 2 3 Blastoff!`.

PUSH and QUEUE have a number of uses, two of which are illustrated in Figure 2. The example in Figure 2(a) also introduces the REXX built-in TIME() function, which returns the current system time. In this instance, the PUSH instruction is used to save the time at which a process starts, and PULL is then used to remove that stored time and compare it to the current time.

In Figure 2(b), the answer to the confirmation question is PUSHed into the input queue to provide a predefined answer to a question. When data has been pushed into the input queue in response to the first question, the second PULL statement does not wait on input from the user. Thus, if the user does *not* want to confirm the operation, the program will still display the confirmation question, and (after completion of the DO block) it will automatically answer YES. Note that in both the previous examples, the QUEUE instruction could have been used in place of the PUSH since only one item was placed in the queue.

USING OS/2 COMMANDS A command language would not be of much use if it could not execute system commands within its programs. As with DOS and the standard OS/2 batch languages, REXX will execute any internal command, batch program, REXX program, or external program that is inserted as a line in the program. For example, the following REXX program copies a file.

```
/*Trivial backup program */
copy program.asm program.bak
```

The only caution you must observe here is to be careful that REXX does not try to process any of the many special symbols that are used both in REXX and in OS/2 commands. For example, in REXX the asterisk (*) is used to indicate multiplication, while both DOS and OS/2 use the asterisk as a wildcard character in filenames. To avoid having REXX process any such special characters, just enclose the command in quotes as shown in the following lines.

```
/* A better backup program */
"copy *.asm *.bak"
```

In this Lab Notes I have only touched the surface of the power of REXX. If you would like to learn more, just give it a try! You'll be amazed by the power it puts at your fingertips. Indeed, while people can still argue over the merits of OS/2, there is no doubt that one of its big pluses is REXX. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR TO *PC MAGAZINE*.

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Manipulating Text Using Outline Fonts under OS/2 2.0

BY CHARLES PETZOLD

It's one thing to use a graphics system such as the OS/2 GPI (Graphics Programming Interface) to draw lines and filled areas, but quite another to use GPI functions to manipulate text using outline fonts. You begin with recognizable glyphs and then change them in various ways. Becoming adept at this can be lots of fun.

The programs in this issue require the OLF (outline font) files discussed in the April 13, 1993 column, as well as the OLFDEMO (outline font demo) shell program shown last time. These files—as well as the source code and executables in this column—can be downloaded from PC MagNet. Look for the OLF files archived as OLF.ZIP, the OLFDEMO program archived as OLFDEM.ZIP, and the files introduced in this column archived as OLFREF.ZIP. (Some of these programs are similar to programs I wrote for an issue of *Microsoft Systems Journal* over four years ago, but the code is often quite different.)

REFLECTED TEXT STRINGS As I've discussed in previous columns, you can scale an outline font to a particular size by calling GpiSetCharBox. This function requires a structure of type SIZEF with two fields named cx and cy. These two fields are treated as 32-bit fixed-point values, with the integral part in the high word and the fractional part in the low word.

The character box is the same as the em-square of the font, which is the point size of the font in both vertical and horizontal directions. Normally, the character-box dimensions must be specified in world coordinates, but the OLF.C module contains a function called ScaleOutlineFont that lets you specify the font point size in decipoints (tenths of a point), regardless of world coordinates.

It may never have occurred to you, but you can use negative values in the SIZEF structure that you pass to GpiSetCharBox and, consequently, in the font point sizes you pass to ScaleOutlineFont. But what does it mean to have a negative point size?

If you set the character box with a negative cx field in the SIZEF structure, then a character string displayed with GpiCharStringAt (or some other GPI text output function) will run from right to left rather than left to right. But it's not like the effect produced by a GpiSetCharDirection call: With a negative character-box width, all the characters are flipped around the vertical axis. It's almost as if you held a mirror at the left side of the character string and looked at the reflection.

Outline fonts can be manipulated to produce some very striking special effects. Five sample programs illustrate just how creative you can get.

If the cy field of the SIZEF structure is negative, the text string is displayed upside down. All the characters are flipped around the horizontal axis, and appear as if you held a mirror along the baseline of the string. If both the cx and cy fields are negative, then the string is displayed upside down and right to left with characters flipped around both the vertical and horizontal axes. In all cases, the point specified in the GpiSetCharStringAt function indicates the baseline of the left side of the first character—even if the ascents of the characters are below the baseline, or if the left side of the first character is actually displayed at the right.

I know that this can be quite confusing, so let's look at an example. The OLFREFL (outline font reflection) program shown in Figure 1 displays the character string "Reflect" using the four combinations of positive and negative character-box sizes.

The function shown in OLFREFL.C sets a POINTL structure to the center of the client window. This is the starting position of the displayed text. The function displays the character string four times with a 72-point Times New Roman font—the first using positive character-box dimensions (displayed in the upper right of the client window), the second using a negative width (displayed at the upper left), the third using a negative height (lower right), and the fourth using a negative width and height (lower left). The results are shown in the "Special Effects" sidebar. See the screenshot in the top, left-hand corner.

COMBINING EFFECTS In the last issue, I showed how to rotate text using the GpiSetCharAngle function. This function requires a structure of type GRADIENTL, which has two fields named *x* and *y* that define a point. A line drawn from the point (0,0)—the origin—to the point (*x*,*y*) defines the angle of the characters and the direction in which the strings are displayed. The default character angle is the point (1,0).

For example, if world-coordinate dimensions are equal along the horizontal and vertical dimensions, and if you specify the point (1,1) in the GpiSetCharAngle function, then any outline font text you display will be tilted 45 degrees counterclockwise and strings will run

OLFREFL.C

Complete Listing

```
/*-----------------------------------------
   OLFREFL.C -- Reflected OS/2 Outline Fonts
                (c) Charles Petzold, 1993
  -----------------------------------------*/

#define INCL_WIN
#define INCL_GPI
#include <os2.h>
#include <string.h>
#include "olf.h"

#define LCID_FONT    1

void PaintClient (HPS hps, SHORT cxClient, SHORT cyClient)
     {
     static CHAR szText [] = "Reflect" ;
     int         i ;
     POINTL      ptl ;

     // Set POINTL structure to center of client

ptl.x = cxClient / 2 ;
ptl.y = cyClient / 2 ;

     // Create the logical font and select it

CreateOutlineFont (hps, LCID_FONT, "Times New Roman", 0, 0) ;
GpiSetCharSet (hps, LCID_FONT) ;

for (i = 0 ; i < 4 ; i++)
     {
     ScaleOutlineFont (hps, (i > 1) ? -720 : 720,
                            (i & 1) ? -720 : 720) ;

          // Display the character string

     GpiCharStringAt (hps, &ptl, strlen (szText), szText) ;
     }

     // Select the default font; delete the logical font

GpiSetCharSet (hps, LCID_DEFAULT) ;
GpiDeleteSetId (hps, LCID_FONT) ;
}
```

Figure 1: **This is the source code for a program that displays reflected character strings.**

from lower left to upper right. For the point (-1,-1), characters are tilted 225 degrees counterclockwise, and strings run from upper right to lower left. Unlike negative character-box values, though, the character angle does not change the actual appearance or ordering of the characters. If you tilted your monitor, the strings would still look normal.

You can combine character angles and negative character-box dimensions. The OLFREFL2 program listed in Figure 2 shows an example of this. The function in OLFREFL2.C is the same as that in OLFREFL.C except that it calls GpiSetCharAngle with *x* and *y* fields of the GRADIENTL structure set to 1 (as you can see in the screenshot in the top, right-hand corner of the "Special Effects" sidebar). The display looks very similar to OLFREFL except that everything is rotated 45 degrees counterclockwise. Of course, these two types of effects are possible only with outline fonts. They won't work correctly with raster fonts.

THE CHARACTER SHEAR Another way to manipulate outline fonts is by using the GpiSetCharShear function. This function determines the "shear" of the characters, that is, the extent to which they tilt to the right or left. For example, a small character shear to the right gives characters an oblique or italic appearance.

It's important to understand the distinction between the character angle and the character shear. Setting a nondefault character angle simply rotates the characters without distorting them in any way. This means that the baseline becomes nonhorizontal. The character shear distorts the characters by tilting them. But the baseline is still horizontal (unless, of course, you also use GpiSetCharAngle or some transform function that performs rotation).

The GpiSetCharShear function requires a POINTL structure. A line drawn from (0,0) to the point (*x*,*y*) indicates the angle of the shear. The default is the point (0,1), which defines a vertical line indicating that the characters stand straight up with no shear. A character shear of (0,-1) produces the same effect. The character shear does not flip characters.

If the *y* field of the POINTL structure is 0, it indicates an infinite shear to the right or the left. Characters would simply be flattened out on the baseline and proceed to infinity. For this reason, *y* fields of 0 raise an error except when both the *x* and *y* fields are set to 0; this sets the default character shear.

The OLFSHEAR program shown in Figure 3 demonstrates what different character shears look like. This program displays 17 character strings down the client window. The function in OLFSHEAR.C loops through 17 angles from 0 degrees through 360 degrees, measured counterclockwise from the horizontal. As in the OLFROT program shown in the last issue, these angles are converted to points by calling the C sin and cos functions. In order to avoid rounding problems, the points are scaled to 100 units.

The output from this program is shown in the middle row of the left-hand side of the sidebar. The display looks a little woozy, almost as if someone had smeared it with his or her fingers. Let's look a little closer. The first line of text uses an angle of 0 degrees (measured counterclockwise from the horizontal), which is converted to the point (100,0). That indicates an infinite shear to the right, which is an error, so the text is displayed normally. The second line is a shear angle of 22.5 degrees. In this string, the vertical bar of the h is at an angle of 22.5 degrees from the horizontal.

The 90-degree line is the default. The point passed to the GpiSetCharShear function is (0,100). After this, the characters tilt progressively to the left. However, a character shear of 180 degrees raises an error, so the character shear is

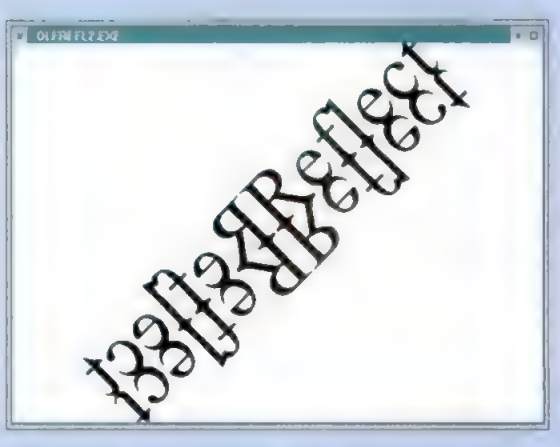
not changed and the line is displayed with the previous character shear of 157.5 degrees.

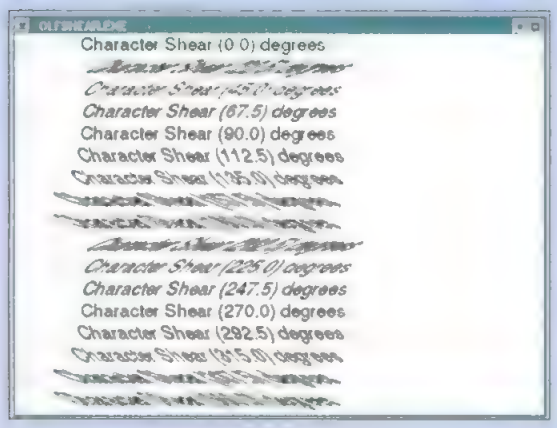
Character shears greater than 180 degrees produce the same effects as the angles 180 degrees less, so the display simply repeats itself. Character shears from 202.5 degrees through 337.5 degrees are the same as shears from 22.5 degrees through 157.5 degrees.

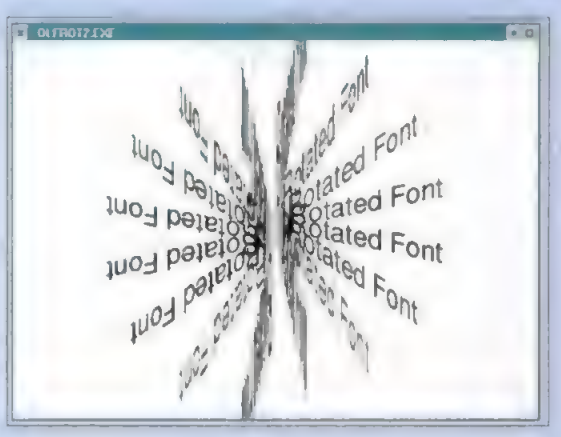
COMBINING EFFECTS, PART 2 In the last installment of this column, I showed a program called OLFROT that used GpiSetCharAngle to display 16 strings rotated around the center of the client window. One interesting exercise is to combine the GpiSetCharAngle and GpiSetCharShear functions to create a display similar to OLFROT, but with the vertical bars of the characters always vertical. This is illustrated in the OLFROT2 program shown in Figure 4.

To avoid infinite shear angles, I begin the angle loop at 11.25 degrees and increment by 22.5 degrees. This angle is used directly for computing the point passed to the GpiSetCharAngle function. To calculate a character shear that compensates for the character angle, I subtract the character angle from 90 degrees and

Special Effects







Five programs running under OS/2 2.0 manipulate outline fonts to create the special effects shown here. In the top left corner, the OLFREFL program displays the character string "Reflect" using the four combinations of positive and negative character-box sizes. Negative character-box dimensions and character angles can be combined, as the OLFREFL2 program shows (top right). The OLFSHEAR program demonstrates what different character shears look like (middle left). The OLFROT2 program shows the effects of manipulating both character shear and character angle (middle right). Finally, the OLFSHAD program illustrates (bottom left) an interesting three-dimensional effect produced by combining somewhat extreme point size, width, and character-shear values.

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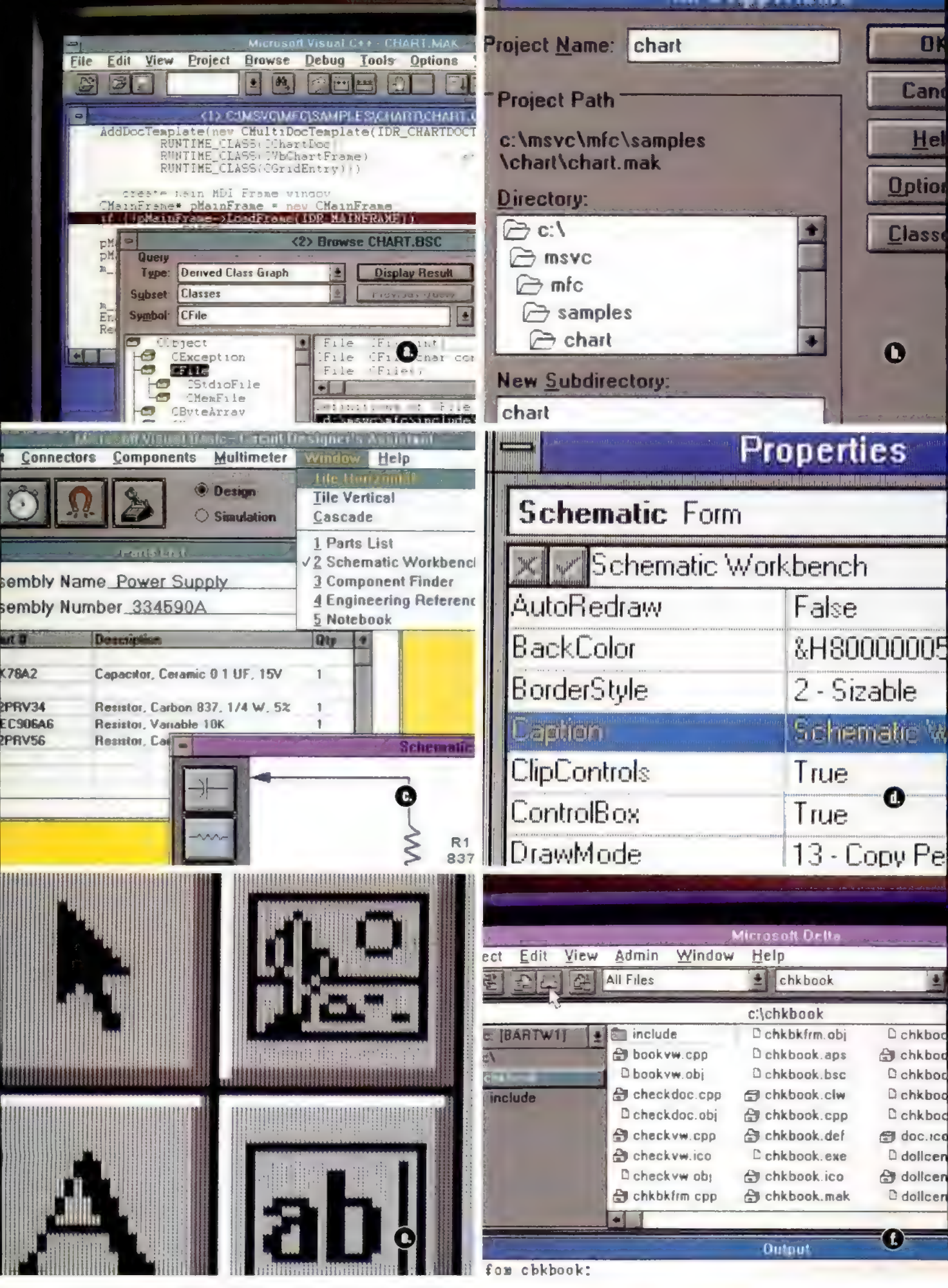
Microsoft Visual C++ - CHART.MAK
File Edit View Project Browse Debug Tools Options
AddDocTemplate(new CMultiDocTemplate(IDR_CHARTDOCT
RUNTIME_CLASS(CChartDoc)
RUNTIME_CLASS(CVbChartFrame)
RUNTIME_CLASS(CGridEntry)))
CMainFrame* pMainFrame = new CMainFrame
<2> Browse CHART.BSC
Query
Type: Derived Class Graph
Subset: Classes
Symbol: CFile
Display Result
CObject
CException
CFile
CStdioFile
CMemFile
CByteArray
Project Name: chart
Project Path
c:\msvc\mfc\samples
\chart\chart.mak
Directory:
c:\
msvc
mfc
samples
chart
New Subdirectory:
chart
Connectors Components Multimeter Window Help
Design
Simulation
Tile Horizontally
Tile Vertical
Cascade
1 Parts List
2 Schematic Workbench
3 Component Finder
4 Engineering Reference
5 Notebook
Assembly Name Power Supply
Assembly Number 334590A
Description
Qty
Capacitor, Ceramic 0.1 UF, 15V
Resistor, Carbon 837, 1/4 W, 5%
Resistor, Variable 10K
Schematic
R1
837
Properties
Schematic Form
Schematic Workbench
AutoRedraw False
BackColor &H80000005
BorderStyle 2 - Sizable
Caption Schematic W
ClipControls True
ControlBox True
DrawMode 13 - Copy Pe
Microsoft Delta
Edit View Admin Window Help
All Files
chkbook
c:\chkbook
include
bookvw.cpp
bookvw.obj
checkdoc.cpp
checkdoc.obj
checkvw.cpp
checkvw.ico
checkvw.obj
chkbkfrm.cpp
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OLFREFL2.C

Complete Listing

```
/*-----------------------------------------------------------
   OLFREFL2.C -- Reflected and Rotated OS/2 Outline Fonts
                 (c) Charles Petzold, 1993
  -----------------------------------------------------------*/

#define INCL_WIN
#define INCL_GPI
#include <os2.h>
#include <string.h>
#include "olf.h"

#define LCID_FONT    1

void PaintClient (HPS hps, SHORT cxClient, SHORT cyClient)
     {
     static CHAR szText [] = "Reflect" ;
     GRADIENTL   gradl ;
     int         i ;
     POINTL      ptl ;

          // Set POINTL structure to center of client

     ptl.x = cxClient / 2 ;
     ptl.y = cyClient / 2 ;

          // Create the logical font and select it

     CreateOutlineFont (hps, LCID_FONT, "Times New Roman", 0, 0) ;
     GpiSetCharSet (hps, LCID_FONT) ;

          // Set character angle

     gradl.x = 1 ;
     gradl.y = 1 ;

     GpiSetCharAngle (hps, &gradl) ;

     for (i = 0 ; i < 4 ; i++)
          {
          ScaleOutlineFont (hps, (i > 1) ? -720 : 720,
                                 (i & 1) ? -720 : 720) ;

               // Display the character string

          GpiCharStringAt (hps, &ptl, strlen (szText), szText) ;
          }

          // Select the default font; delete the logical font

     GpiSetCharSet (hps, LCID_DEFAULT) ;
     GpiDeleteSetId (hps, LCID_FONT) ;
     }
```

Figure 2: **This is the source code for a program that displays reflected character strings at an angle.**

OLFSHEAR.C

Complete Listing

```
/*-----------------------------------------
   OLFSHEAR.C -- Sheared OS/2 Outline Fonts
                 (c) Charles Petzold, 1993
  ---------------------------------- --------*/

#define INCL_WIN
#define INCL_GPI
#include <os2.h>
#include <math.h>
#include <stdio.h>
#include <string.h>
#include "olf.h"

#define LCID_FONT    1
#define TWO_PI       (2 * 3.14159)

void PaintClient (HPS hps, SHORT cxClient, SHORT cyClient)
     {
     CHAR        szBuffer [32] ;
     double      dAngle ;
     FONTMETRICS fm ;
     POINTL      ptl, ptlShear ;

          // Set POINTL structure to near-left top of client

     ptl.x = cxClient / 8 ;
     ptl.y = cyClient ;

          // Create the logical font, select it, and scale it

     CreateOutlineFont (hps, LCID_FONT, "Helvetica", 0, 0) ;
     GpiSetCharSet (hps, LCID_FONT) ;
     ScaleOutlineFont (hps, 160, 160) ;

     GpiQueryFontMetrics (hps, sizeof (FONTMETRICS), &fm) ;

          // Loop through the shear angles

     for (dAngle = 0 ; dAngle <= 360 ; dAngle += 22.5)
          {
               // Set the shear angle

          ptlShear.x = (LONG) (100 * cos (TWO_PI * dAngle / 360)) ;
          ptlShear.y = (LONG) (100 * sin (TWO_PI * dAngle / 360)) ;

          GpiSetCharShear (hps, &ptlShear) ;

               // Display the character string

          ptl.y -= fm.lMaxAscender ;

          GpiCharStringAt (hps, &ptl,
              sprintf (szBuffer, "Character Shear (%.1f)
degrees", dAngle),
                       szBuffer) ;

          ptl.y -= fm.lMaxDescender ;
          }

          // Select the default font; delete the logical font

     GpiSetCharSet (hps, LCID_DEFAULT) ;
     GpiDeleteSetId (hps, LCID_FONT) ;
     }
```

Figure 3: **This is the source listing for a program that displays several sheared character strings.**

OLFROT2.C

Complete Listing

```
/*-----------------------------------------------------
   OLFROT2.C -- Rotated and Sheared OS/2 Outline Fonts
                (c) Charles Petzold, 1993
  -----------------------------------------------------*/

#define INCL_WIN
#define INCL_GPI
#include <os2.h>
#include <math.h>
#include <string.h>
#include "olf.h"

#define LCID_FONT    1
#define TWO_PI       (2 * 3.14159)

void PaintClient (HPS hps, SHORT cxClient, SHORT cyClient)
     {
     static CHAR szText [] = "  Rotated Font" ;
     double      dAngle ;
     GRADIENTL   gradl ;
     POINTL      ptl, ptlShear ;

          // Set POINTL structure to center of client

     ptl.x = cxClient / 2 ;
     ptl.y = cyClient / 2 ;

          // Create the logical font, select it, and scale it

     CreateOutlineFont (hps, LCID_FONT, "Helvetica", 0, 0) ;
     GpiSetCharSet (hps, LCID_FONT) ;
     ScaleOutlineFont (hps, 240, 240) ;

          // Loop through the character angles

     for (dAngle = 11.25 ; dAngle < 360 ; dAngle += 22.5)
          {
               // Set the character angle

          gradl.x = (LONG) (100 * cos (TWO_PI * dAngle / 360)) ;
          gradl.y = (LONG) (100 * sin (TWO_PI * dAngle / 360)) ;

          GpiSetCharAngle (hps, &gradl) ;

               // Set the character shear

         ptlShear.x = (LONG) (100 * cos (TWO_PI * (90 - dAngle) / 360)) ;
         ptlShear.y = (LONG) (100 * sin (TWO_PI * (90 - dAngle) / 360)) ;

          GpiSetCharShear (hps, &ptlShear) ;

               // Display the character string

          GpiCharStringAt (hps, &ptl, strlen (szText), szText) ;
          }

          // Select the default font; delete the logical font

     GpiSetCharSet (hps, LCID_DEFAULT) ;
     GpiDeleteSetId (hps, LCID_FONT) ;
     }
```

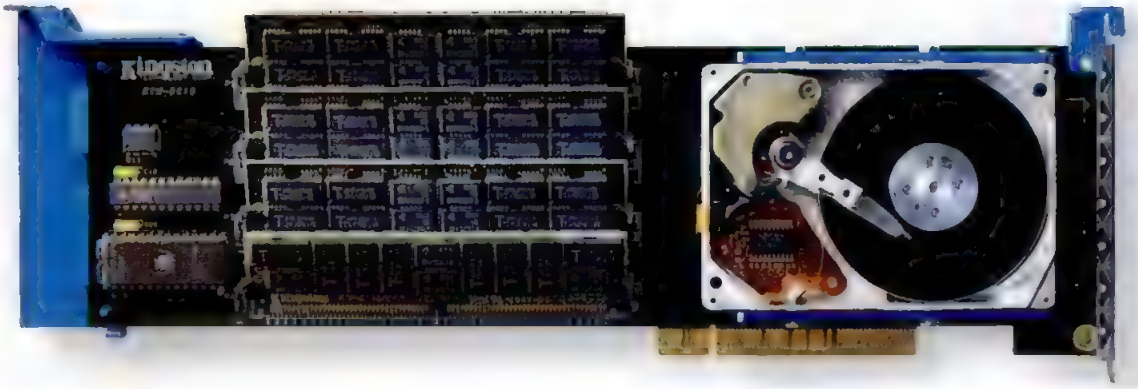
Figure 4: **This is the source listing for a program that displays several sheared character strings.**

OLFSHAD.C

Complete Listing

```
/*-----------------------------------------
   OLFSHAD.C -- Shadowed OS/2 Outline Font
                (c) Charles Petzold, 1993
  -----------------------------------------*/

#define INCL_WIN
#define INCL_GPI
#include <os2.h>
#include <string.h>
#include "olf.h"

#define LCID_FONT    1

void PaintClient (HPS hps, SHORT cxClient, SHORT cyClient)
     {
     static CHAR szText [] = "Shadow" ;
     POINTL      ptl, ptlShear ;

          // Color the client window

     GpiSetColor (hps, CLR_BLUE) ;

     ptl.x = 0 ;
     ptl.y = 0 ;
     GpiMove (hps, &ptl) ;

     ptl.x = cxClient ;
     ptl.y = cyClient ;
     GpiBox (hps, DRO_FILL, &ptl, 0, 0) ;

          // Create the logical font

     CreateOutlineFont (hps, LCID_FONT, "Times New Roman", 0, 0) ;
     GpiSetCharSet (hps, LCID_FONT) ;

          // Display the shadow

     GpiSetColor (hps, CLR_DARKBLUE) ;

     ScaleOutlineFont (hps, 2160, 720) ;

     ptlShear.x = 2 ;
     ptlShear.y = 1 ;
     GpiSetCharShear (hps, &ptlShear) ;

     ptl.x = cxClient / 8 ;
     ptl.y = cyClient / 4 ;
     GpiCharStringAt (hps, &ptl, strlen (szText), szText) ;

          // Display the text

     GpiSetColor (hps, CLR_RED) ;

     ScaleOutlineFont (hps, 720, 720) ;

     ptlShear.x = 0 ;
     ptlShear.y = 1 ;
     GpiSetCharShear (hps, &ptlShear) ;

     GpiCharStringAt (hps, &ptl, strlen (szText), szText) ;

          // Select the default font; delete the logical font

     GpiSetCharSet (hps, LCID_DEFAULT) ;
     GpiDeleteSetId (hps, LCID_FONT) ;
     }
```

Figure 5: **This is the listing for a file that uses character shear to mimic a shadow.**



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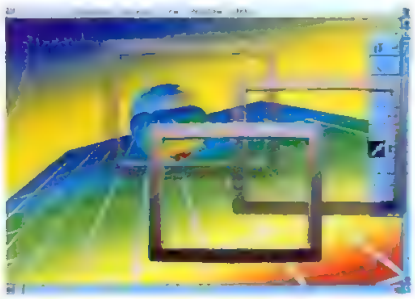

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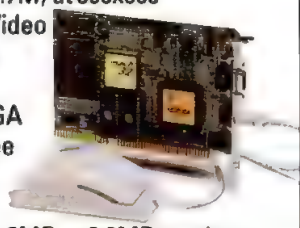

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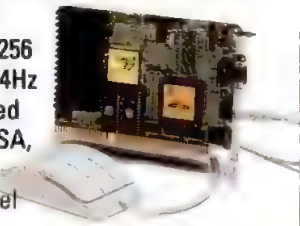

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use that to calculate the point passed to the GpiSetCharShear function. As you can see in the middle, right-hand screenshot in the "Special Effects" sidebar, the vertical stroke of the F (and other characters, of course) is always vertical. Toward the center of the display, the shear is so extreme that the text is unreadable.

THREE-DIMENSIONAL EFFECTS Look at the right side of that same screenshot, avoiding the unreadable strings. Does it seem to you as if the top three character strings are going into the display and the bottom three are coming out of the display? Character shear that is somewhat more extreme than normal italic text can certainly produce some interesting three-dimensional effects. The tilt of the characters makes it seem as if we're looking at the string from an angle. The OLFSHAD (outline font shadow) program shown in Figure 5 uses character shear to create a "shadow" for a character string.

Character shear that is somewhat more extreme than normal italic text can produce some interesting three-dimensional effects.

The function in OLFSHAD.C begins by coloring the background of the client window blue. It then displays the string "Shadow" using a Times New Roman font in dark blue. (This is the shadow.) The font is scaled to 216 points, but with an em-width of 72 points. Thus the font is three times as high as a normal 72-point font. The program sets the character-shear point to (2,1). Next, the function displays the same string in red, with a point size of 72 and no shear. The results are shown in the screenshot on the bottom, left-hand side of the sidebar. As you can see, it looks as if the red character string is standing up, throwing a tall sheared shadow behind it. In the next issue, we'll look at some other special effects that can be created using outline fonts. □

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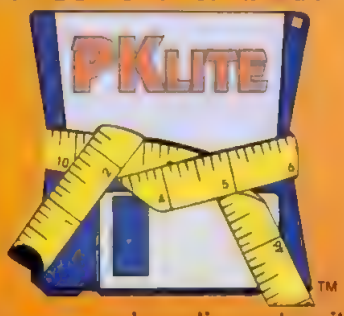

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Building the Basic Structure of a Windows Help File

BY RAY DUNCAN

The authoring of a Windows help file is an extremely important part of any Windows application development project. Unfortunately, it is the part of the project that often gets slighted or postponed until very late in the development cycle. Additionally, the design and implementation of a high-quality help file is not a task the average programmer is well qualified to pursue, regardless of his or her other talents. The Windows Help System can be a powerful ally but, when help files are put together by amateurs, the results can be truly grotesque.

In the best case, help file design and development should be carried out by a team that includes the application designer, a technical writer, an experienced manuscript editor, a graphics designer/typographer, and a user-interface designer. Of course, only big companies like Microsoft have the luxury of deploying such a formidable team of experts against a help file project. The rest of us must simply do the best we can, using help files created by experts as models and seeking advice from more experienced developers where we can find it. Again, I strongly recommend that you obtain the Microsoft Developer Network CD-ROM and carefully study the "Help File Authoring Guide" included on that disk.

In the last issue, we discussed some general philosophical considerations regarding help files, as well as components of the help file system. In this column, we'll move forward with the implementation of a help file for the EXELOOK program that was published earlier this year in several Power Programming columns.

DESIGNING THE HELP FILE Probably the most important step in help file development is the one you carry out with a pencil and paper before you even touch a computer: the design of your help file's logical structure. (The logical structure is the structure that the end user perceives; not the actual, physical structure.) Several objectives need to be kept in mind during this process.

- Help screens should be clean, attractive, and uncluttered (avoiding excessive use of different fonts, small fonts, and lots of colors).
- The organization of the help file should reflect the user's expectations as well as the organization of the program it describes.
- The user must be able to navigate through the help file quickly and easily; there should be no surprises or dead ends.
- The user should be able to move quickly from task-oriented overviews to detailed information about a specific feature and vice versa.
- There should be multiple routes to any desired chunk of information.
- Every topic in the file should be searchable under all possible synonyms and aliases.
- No feature of the program should be left unmentioned.

This practical example of the construction of a help file outlines the basic structure of help files and the steps to follow to implement them in your own applications.

To start, you might just write down a list of all the subjects and aspects of your program that deserve an individual explanation in the help file. For example, there should be an overview of what the program does, an entry for each of the program's menu items, and a description of each task that can be accomplished with the program. Once you've completed such a list, try to gather its components into a relatively small number of groups—a group of menu items, a group of tasks, and so on.

The second step is to sketch out the relationship between the help file's table of contents and the various chunks of information in the help file. Since one of the objectives is to keep screens uncluttered, you want to avoid table of contents screens that have more than, say, eight or ten distinct items. Thus, in most cases, you'll end up with a multilevel table of contents where the initial contents screen for the help file will lead to a more specialized table of contents for each of the subject groups, and thence to the actual help text. My own sketch for the organization of the help file for the EXELOOK utility is shown in Figure 1. As you can see from the figure, you can think of the help file's logical organization at this early stage as being much like a decision tree (but certainly not a binary tree or a balanced tree).

CREATING A HELP FILE SKELETON Now you're ready to lay hands on the keyboard. Create a new directory that will hold all the files associated with your help file. (Doing this will allow you to back up the files as a set easily before you make any major changes.) Fire up your word processor and create an empty document file for the table of contents, and one file each for the branches of the tree under the table of contents. In the case of Figure 1, you'd create four files that

you might name CONTENTS.DOC, OVERVIEW.DOC, MENUS.DOC, and TECHINFO.DOC.

Once all the empty files are created, it's easy to turn them into a skeleton of the final help file. Within each file, type a series of lines that will ultimately be the headings for all chunks of information held in that file. The CONTENTS.DOC file is no different from the others in this respect, since the contents screens have no special status from the point of view of the help file viewer (except that one of them is designated as the first screen to be displayed when the help file is opened). For example, you might enter the following lines into the CONTENTS.DOC file.

```
Table of Contents
Index to General Information
Index to Menu Descriptions
Index to Technical Information
```

And for MENU.DOC you might enter these lines:

```
File Menu
Display Menu
Help Menu
```

Next, insert a hard page break before the first line, between each line, and after the last line of each file. These hard page breaks tell the help file compiler where to divide one help file chunk of information from another. The text between two page breaks is presented as a single unit, called a topic, within the help file viewer's window. The first line of a topic, which is the topic's heading as far as the end-user is concerned, has no special status for the help file compiler or help file viewer program; you're just using topic headings for now as placeholders, and as something recognizable for you to look at when you're compiling the help file skeleton.

Now it's time to assign "context strings" to each topic, including the topics in CONTENTS.DOC. Context strings are merely labels that the help compiler can recognize and resolve as the target of a hyperlink jump from elsewhere in the file. A context string is associated with a topic—that is, the topic is assigned a symbolic label for the help compiler's use—by creating a footnote with the special footnote character # at the very beginning of the topic. If you're using WinWord, you must position the caret immediately after the page break that delimits the beginning of the topic, select Insert Footnote, type the # character as the footnote character in the dialog box, then type the desired context string as the contents of the footnote. Keep in mind that the context string cannot contain embedded blanks.

Help File Structure

Figure 1: This depicts the organization of the help file for the EXELOOK.EXE utility.

You want to pick context strings that are unique and easy to remember, and assign them according to some simple convention. For example, the context strings for the topics located in CONTENTS.DOC might be assigned as follows:

```
contents_main
contents_overview
contents_menu
contents_techinfo
```

while those for topics in MENU.DOC might be assigned like so:

```
menu_file
menu_display
menu_help
```

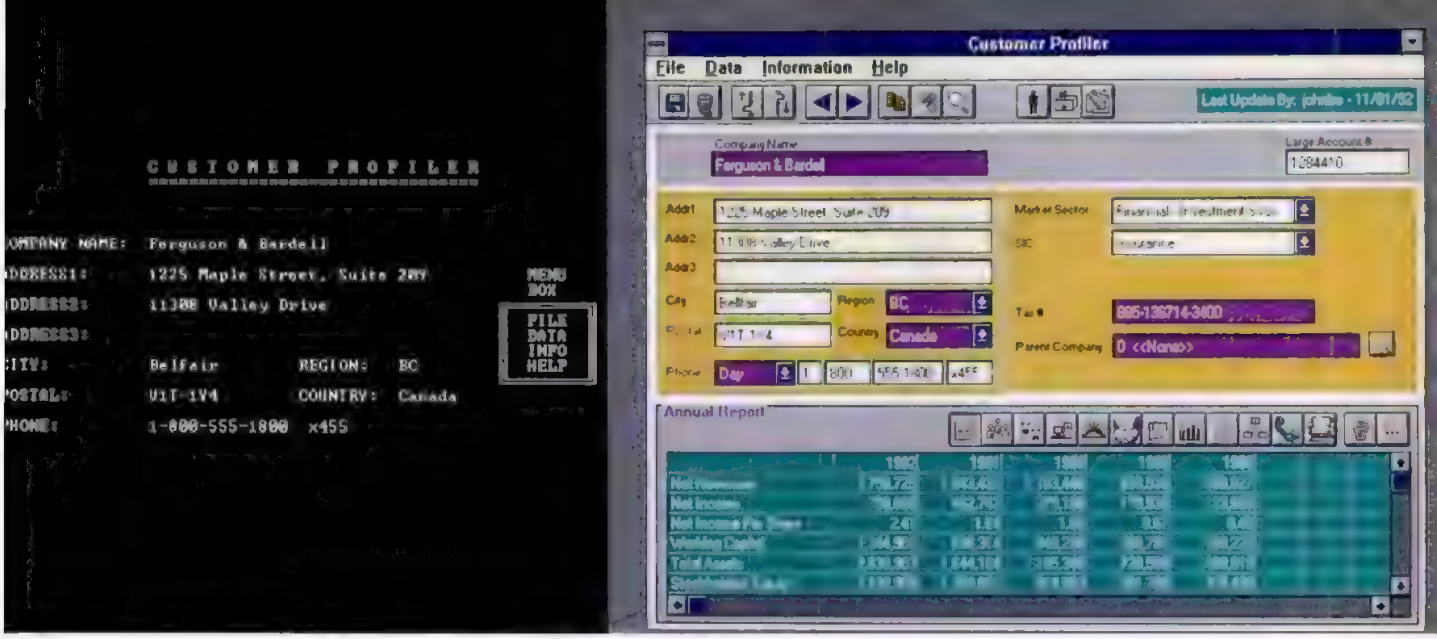
At this point, you've got a set of very odd-looking document files where each file consists of pages that are empty except for a single line at the top, with each page's single line preceded by a # footnote indicator, and with a single footnote located at the bottom of each page. If you're editing MENU.DOC in WinWord 2.0 with the footnote window open, you'll see something like the screen shot shown in Figure 2.

Now go back to CONTENTS.DOC. Amplify the main and subsidiary tables of contents so that the first page of the file contains the following text.

```
Table of Contents

Index to General Information
Index to Menu Descriptions
Index to Technical Information
```

The second page should look like this:



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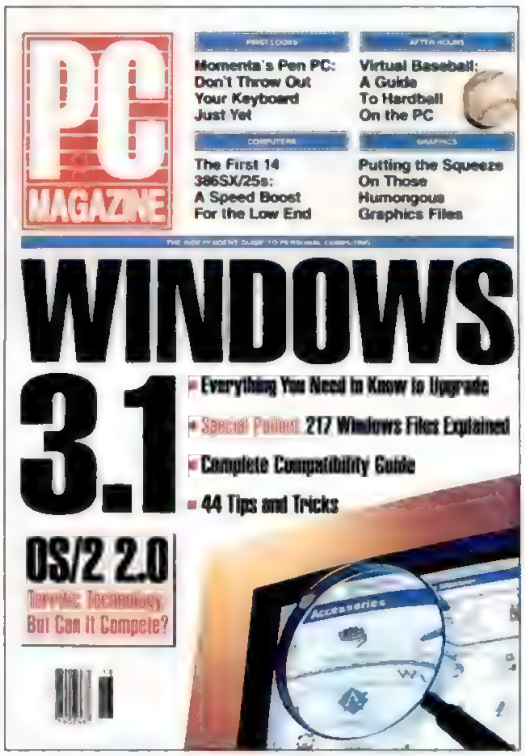

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```
Index to General Information

Program Overview
Release History
Known Bugs and Limitations
Copyright Notice
```

The third page of CONTENTS.DOC should say

```
Index to Menu Descriptions

File Menu
Display Menu
Help Menu
```

And I'll leave the text of the fourth page to your own imagination.

INSTALLING THE FIRST HYPERLINKS You are now ready to add the hyperlinks in CONTENTS.DOC that will let you jump down through the levels of the table of contents and from there to the leaves of the help file topic tree. A simple text hyperlink is created by formatting the text that will be visible to the user as the hyperlink with a double-underline (by default, the hyperlink text is displayed in green with a single underline), then inserting the context string that is the destination of the hyperlink as "hidden text" immediately after the hyperlink text with no intervening spaces. The contents of the text that is visible to the user as the hyperlink can be anything, but the context string that is inserted as hidden text must exactly match the context string that was assigned to the destination topic with the # footnote. The first page of the CONTENTS.DOC file, after inserting hyperlinks, should look like Figure 3 if you're using WinWord.

When everything seems satisfactory in each of the four document files, save the files in the their native word processor format and additionally export each of them as a Rich Text Format (RTF) file. You should now have eight files in your help project directory:

```
CONTENTS.DOC
CONTENTS.RTF
OVERVIEW.DOC
OVERVIEW.RTF
MENU.DOC
MENU.RTF
TECHINFO.DOC
TECHINFO.RTF
```

Throughout the remainder of the help file development cycle, you'll only edit the document (.DOC) files. The RTF files are the input to the help file compiler so you'll need to re-export them each time you rebuild the help file for testing, but they have no other purpose.

COMPILING THE HELP FILE SKELETON You're almost ready to compile the help file skeleton. But before you can run the help file compiler (HC31.EXE), you have to create a help project (HPJ) file that tells the compiler which files to process, the topic name for the main "contents" screen, the title for the help file window, and other crucial information. The possible directives that can be placed in an HPJ file were summarized in the last column; for our purposes here you can create a simple help project file named EXELOOK.HPJ that reads like this:

```
[OPTIONS]
CONTENTS=contents_main
TITLE=EXELOOK Help
[FILES]
CONTENTS.RTF
OVERVIEW.RTF
MENU.RTF
TECHINFO.RTF
```

The HPJ file must be saved as a plain ASCII text file; it should not be saved as a word processor document (.DOC) file or a rich text format (RTF)

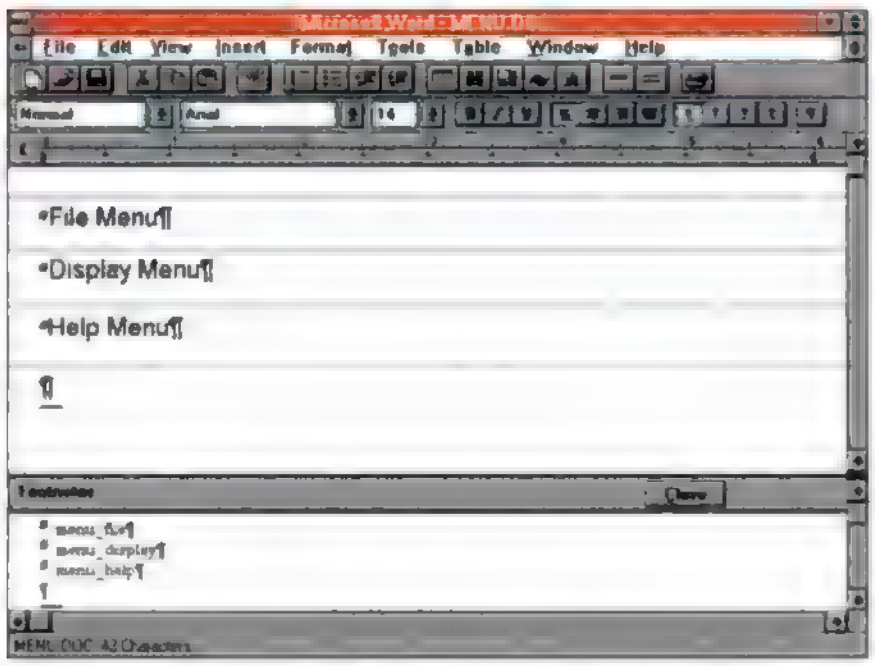

Figure 2: **This screen shot shows Word for Windows 2.0 while editing the MENU.DOC file skeleton, with topic separators (hard page breaks), topic headings, and topic labels (context string footnotes) in place.**

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file. Make sure that the HPJ file is in the same directory with the RTF files, then run the help file compiler with the name of the HPJ file as the command line parameter. For example:

```
C>HC31 EXELOOK <Enter>
```

Note that the extension HPJ is assumed and need not be entered. The help file compiler will chug along for a while, displaying a dot on the screen each time it crunches up a topic (and maybe a few warning messages), and will finally terminate, leaving behind, in this case, a new help file called EXELOOK.HLP.

TESTING THE HELP FILE SKELETON You can test your compiled help file skeleton EXELOOK.HLP with the File-Run command in the Windows Program Manager. Enter either the path and name of the help file alone, or the name of the Windows help file viewer (WINHELP .EXE) followed by the name of the help file as the command line parameter. If all goes as expected, the help file viewer should appear with the first page from CONTENTS.DOC visible in the main window (this was controlled by the CONTENTS= directive in the HPJ file) and the text specified by the HPJ file's TITLE= directive in the window's title bar. (See Figure 4.)

You should now navigate up and down each of the branches of the help file tree, using the hyperlinks displayed in green and the "Back" button under the WINHELP.EXE menu bar, until you are satisfied that all the fundamental linkages and sections of the help file's logical tree are present and working as expected. Try to put yourself in the end-user's shoes, and make sure that the hyperlinks describe their destinations clearly and completely.

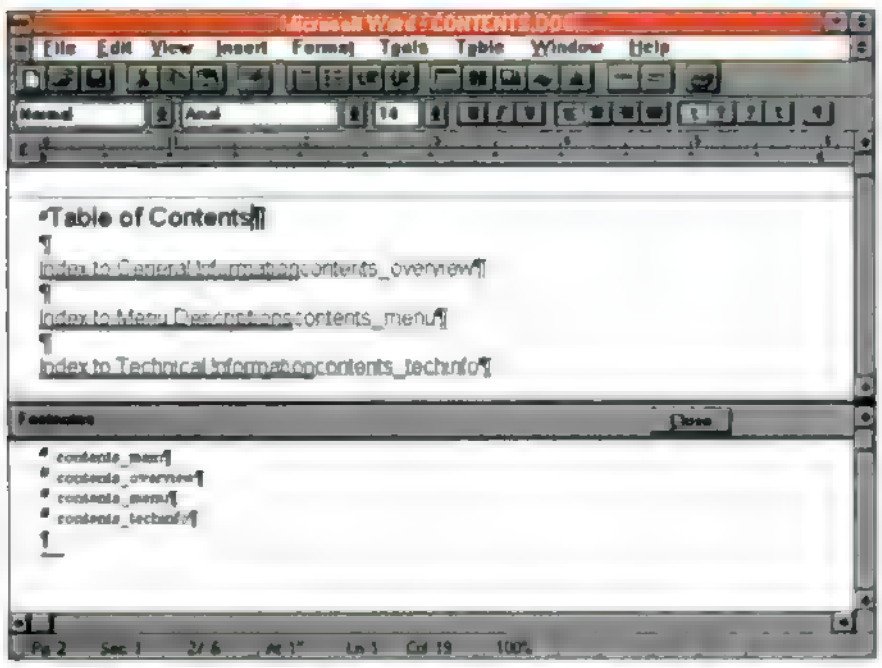

Figure 3: **This is a screen shot of Word for Windows 2.0 while editing the CONTENTS.DOC file, showing the first page of the file with hyperlinks added.**

FILLING IN THE SKELETON Close the help engine now and return to your word processor. Open up each of the help information source files—OVERVIEW.DOC, MENU.DOC, and TECHINFO.DOC—and flesh out each topic by adding explanatory text under the topic's title. Write clearly but informally, avoid lengthy paragraphs, run-on sentences, and techno-jargon, and keep each paragraph about the same length. Don't get carried away with fonts or colors; a sans serif font such as Arial in 12- to 18-point bold is good for topic titles, and 10- or 12-point plain Arial is fine for the body text. Other fonts should be reserved for extraordinary occasions, and colors other than black should almost always be avoided.

Don't worry about the margins when you compose the topic's body text—just set the margins so you can see what you are writing. The help file viewer mostly ignores your margins anyway (except for left-hand indents); if the text is too wide to fit into the help viewer's window, each paragraph is "reflowed" so both margins are visible (with a couple of exceptions that we'll discuss in the next issue). Bring up a help file in the help file viewer and play around with resizing the viewer's window to see this effect for yourself.

If the text of a topic is too long to fit into the help viewer's window, a scroll bar is added to the window and the user can move through the topic by clicking the scroll bar or dragging the thumb. The body of a topic should be neither too short nor too long, and this is a judgement that becomes easier with experience. Topics that consist of only one or two paragraphs are generally too short. (These can be better implemented as pop-up windows, which we'll also discuss in the next column.) Topics that are more than twice the length of an "average-size" help viewer window are probably too long and should be subdivided.

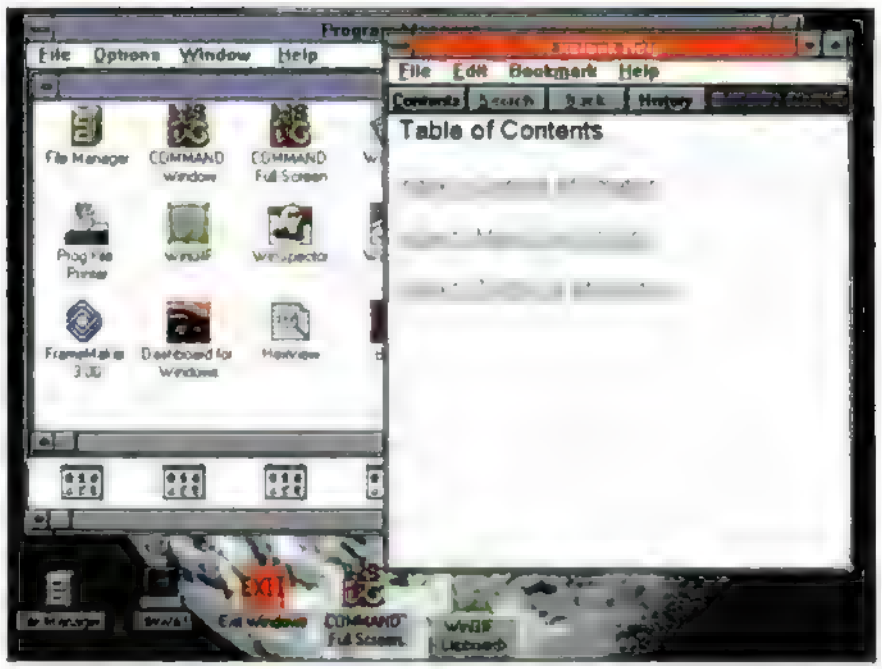

Figure 4: **This shows the main contents page of the EXELOOP.HLP help file skeleton, viewed with WINHELP.EXE.**

When you're done editing the first version of the complete help text into the document files, save the files in their word processor document format. Then export them again as RTF files and rerun the help file compiler. View the results of your labors (the recompiled EXELOOK.HLP file) with WINHELP.EXE. Now you'll become acutely aware of the first hard lesson of help file development: The look of the help text within the word processor—particularly in terms of spacing and alignment—is not a good predictor of how that same text will appear in the Windows help viewer. The second hard lesson is that getting the text to look the way you want takes seemingly endless twiddling. And the third hard lesson is that the help file compiler is agonizingly slow.

In the next issue, I'll show you how to add code to your application to activate its help file, then we'll move on to more sophisticated help file facilities such as bitmaps, keywords for searches, pop-up windows, secondary windows, and macros. Meanwhile, you can download my versions of the DOC, RTF, and HPJ files that form the basis of EXELOOK .HLP from the Programming Forum on PC MagNet, archived as EXEHLP.ZIP.

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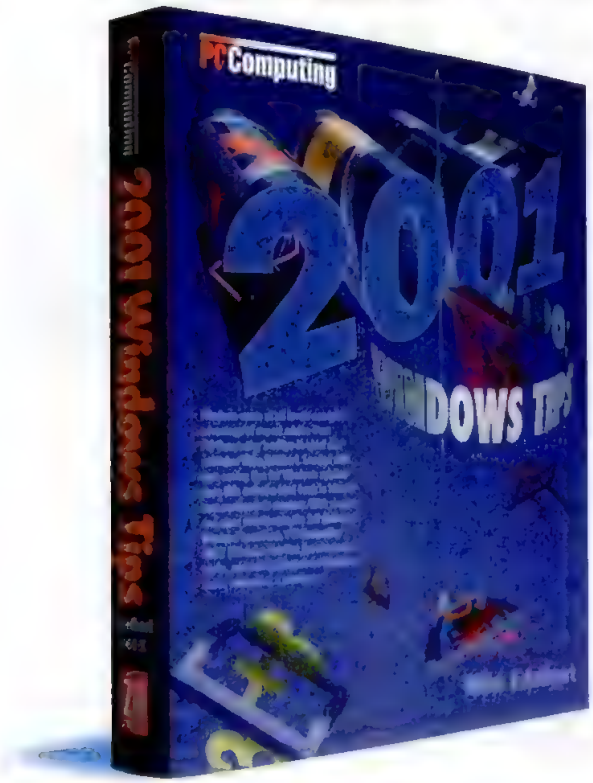

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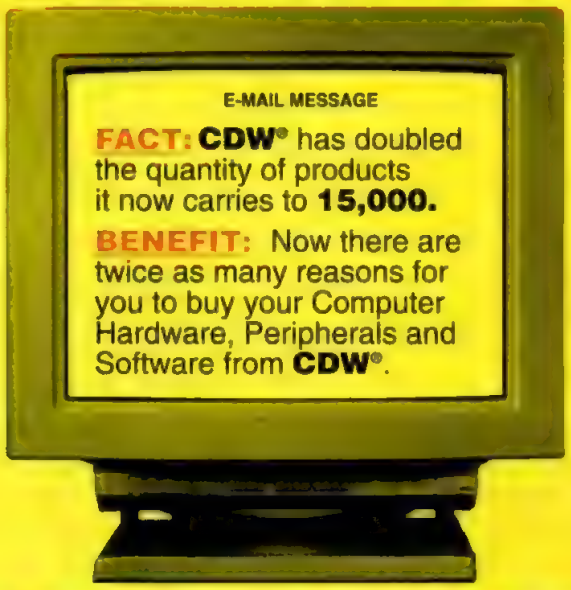

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PCs

DEFEATING SCREEN FLICKER

❓ My screen flickers when I'm working in Windows. Do you know what might be causing this? Is there anything I can do, short of buying a new monitor?

Jake McKenzie
Seattle, Washington

▶**PC MAGAZINE:** Until advanced LCD and other flat screen technologies get out of the lab and into the market, we're more or less stuck with our CRT (cathode ray tube) displays. Many users find the flicker from these screens to be a problem, especially working in Windows with the white background display.

Sure, you can spend a thousand dollars or more for a new display system with fast refresh rates, but there are some other ways to take care of the flicker.

One simple step is to make sure you're actually running at the highest refresh rate (or vertical scan rate) possible. The refresh rate is the rate at which *all* the information on the screen is updated. It isn't easy to tell for sure without special test equipment what rate your system is using. Most users will have to resort to a careful reading of the video adapter's documentation; video cards usually come with a utility that lets you choose different display modes, including different refresh rates. If you have any doubts, contact the board manufacturer.

You may need to step down to a lower resolution in order to get a higher refresh rate. Video adapters are limited in the amount of information they can display in a given time. If you use a resolution that has more pixels, or more information per pixel (more colors), you may need to use a slower refresh rate.

This effect is most obvious with cards (or monitors) that require an interlaced display mode for 1,024-by-768 resolutions; this means only half the image is updated at a time. Interlaced images tend to flicker more than noninterlaced images. Step down to 800-by-600, and the same system can produce a noninterlaced image. By the same token, a system that can only handle a 60 Hz noninterlaced refresh rate at 1,024-by-768 resolution may be able to produce an 800-by-600 image with a 70 or 72 Hz refresh rate.

Upgrading your entire display subsystem can be expensive, but Super VGA adapters have dropped significantly in price; you can often upgrade for less than $200. Make sure your monitor can handle a higher refresh rate, however, before you make the investment. Your monitor's documentation may list supported refresh rates in the specifications section, or you can call the vendor.

Finally, there's one more simple change you can make to reduce flicker. Most offices have fluorescent lighting, which creates light that pulses sixty times per second using a process that is similar to your computer's CRT. This pulsing light source can create annoying interference patterns with the scan rate of your monitor, accentuating the flicker. If possible, shield your monitor from direct fluorescent lighting, and use the steady glow of an incandescent light bulb instead.—*Alfred Poor*

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT COM and EMS40 SYS
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Alfred Poor is a contributing editor and the author of the *Hewlett-Packard LaserJet Printer Handbook*
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Sal Ricciardi is a contributing editor and the author of the forthcoming *Running FoxPro* books from Microsoft Press
Neil J. Rubenking is technical editor and the author of two Turbo Pascal books and *PC Magazine DOS Batch File Lab Notes*
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M. David Stone is a contributing editor and coauthor of *Word for Windows Companion*, Second Edition.
Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

HEAD PARKING UTILITIES

❓ I have a notebook computer with a Conner hard disk. Should I run a head park utility before turning it off?

Jim Jernigan
Madison, Alabama

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▶**PC MAGAZINE:** Do not use a head park utility on your Conner drive!

Older hard disk designs used stepper motors to position the read/write heads, and when the power was turned off, the heads would settle wherever they happened to be. In order to minimize the risk of damage to the disk, it was a good idea to use a head parking utility, which would position the heads over a safe zone where no data was recorded.

Newer designs—including Conner drives—use voice-coil technology to position the heads. When the power is turned off, the heads are automatically retracted to a safe landing zone, so you don't need to use a head parking utility. Furthermore, using these utilities can damage the drive: Head parking programs try to force the head off the data area of the disk and can try to push the heads beyond the last cylinder of the drive, causing them to bang repeatedly against a stop. While this shouldn't cause a problem if done once or twice, frequent use of a parking utility could damage the drive.—*Alfred Poor*

HOW TO CONTACT US

Do you have a hardware, software, or systems problem you can't solve? Do you have a tip you think other readers could use? Or maybe you'd like a better understanding of how something works. If so, we invite you to let us know about it. Our experts can give you practical solutions to your problems, provide techniques for using your software and hardware more productively, and help you grasp computer concepts and understand the latest technology.

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Operating Environments

STANDALONE NETWORK?

❓ I need to program a multiuser dBASE application without having to buy a LAN. Is there any way I can simulate a network environment on a standalone machine?

Willy Goh
Singapore

▶**PC MAGAZINE:** The easiest way to simulate a multiuser environment on a standalone machine is to use a multitasking environment or operating system. A multitasking environment lets you run multiple programs at the same time, so you can load two or more copies of your dBASE application and log on to each copy as a different user.

The only downside is that dBASE assumes it's the only program running on the PC and it needs just about all the memory DOS can provide. You'll need a lot of additional RAM in your machine to run multiple copies—4MB RAM would probably be the minimum. And I wouldn't recommend doing this on a lesser system than a 386SX, both for speed and for the better memory management provided by the 80386 architecture.

The best environment for your purposes is Quarterdeck's DESQview (Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405; 800-354-3222, 310-392-9851; $130), a DOS-based multitasking environment that lets you run multiple programs in either full-screen or smaller windows. If you have a 386SX or better and don't already have memory management software (other than that provided by PC/MS-DOS 5.0), you can buy DESQview/386, which includes Quarterdeck's QEMM.SYS 80386 memory manager, to provide more efficient use of your system's RAM (see "Nine Memory Managers Open Up New Frontiers," *PC Magazine*, Feb. 11, 1992, for more information on 386 memory managers).

You can also use Microsoft Windows (Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-227-4679, 206-882-8080; $150) in 386 Enhanced mode to multitask DOS-based programs. You may find that Windows' GUI (graphical user interface) adds more processing overhead than you're willing to live with; on the other hand, you'll be ready to switch your application to a GUI environment if and when your customers demand it.

You'll need to run the DOS SHARE program with either environment to successfully run multiple copies of dBASE. SHARE provides DOS machines with the same file locking and sharing capabilities that LANs use, so your multiuser application will behave properly on a standalone machine.

In either case, be aware that you're running a multitasker on top of a primarily single-tasking operating system. Both DESQview and Windows push the limits of what DOS can handle when it comes to running multiple programs at the same time, so don't expect to be able to run much more than three or four simultaneous versions of your application on a 4MB system. If you're willing to devote the additional resources needed, you can get true multitasking on a 386SX or better system by using IBM's OS/2 2.0 (IBM Corp., Old Orchard Rd., Armonk, NY 10504; 800-426-2468, 914-765-1900;

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$195). OS/2 was designed from the ground up as a multitasking operating system that supports virtual memory; it uses the hard disk to provide additional system memory when you've overcommitted the system's RAM. Version 2.0 includes the ability to multitask DOS and Windows applications in addition to native OS/2 applications. IBM recommends a minimum of 4MB RAM and 60MB hard disk space, but real-world experience has shown that 6MB to 8MB RAM and 120MB disk space are more realistic minimums. There isn't an OS/2 version of dBASE available yet, so you'll have to run your application in DOS sessions. File locking and sharing is built into OS/2, so there's also no need to run SHARE.
—*Joe Salemi*

FONTS IN WINDOWS

❷ Can you direct me to a source that explains exactly how ATM and TrueType work, how they interact with each other and Windows, and what exactly goes on in the WIN.INI file? I'd like to know the details, rather than depending blindly on the setup programs.

William Sommerwerck
Bellevue, Washington

▶**PC MAGAZINE:** You're in luck! Contributing editor Edward Mendelson's feature, "Typecasting," in the October 27, 1992, issue of *PC Magazine* is a detailed discussion of using scalable fonts in Windows, including TrueType and ATM. TrueType is a more advanced technology than ATM, but the number of fonts available for use by ATM is vastly greater than the number of TrueType fonts. The article provides a lucid explanation of how both systems work and the advantages and disadvantages of each.

As for the TrueType lines in the WIN.INI file, these and all entries in WIN.INI, SYSTEM.INI, PROGMAN .INI, CONTROL.INI, and WINFILE .INI are explained in Microsoft's *Windows Resource Kit.* This $20 book/disk combination is an essential tool for any Windows user who wants to really understand Windows.

Here are the four standard keys that may appear in the [TrueType] section of WIN.INI and their jobs:

- TTEnable=0¦1 controls whether Windows makes TrueType fonts available to applications. If this key is absent or its value is 1, TrueType fonts are available. If the value is 0, they are not.
- TTOnly=0¦1 controls whether Windows makes *non*-TrueType fonts available. If the value is 1, Windows will make only TrueType fonts available. If the key is absent or the value is 0, all fonts are available.
- TTIfCollisions=0¦1 controls what happens when a TrueType font and another installed font have the same name. If the value is 1, the TrueType font will be used. If the key is absent or the value is 0, the other font is used.
- OutlineThreshold=pixels-per-em determines the size at which Windows will render TrueType fonts as outline fonts rather than bitmapped fonts. Decreasing this value from the default of 256 saves memory but makes rendering of TrueType fonts slower. Increasing it beyond 300 can cause problems.

Your own particular WIN.INI may contain any or all of these keys.
—*Neil J. Rubenking*

Word Processing

MOVING FILES IN WORD FOR DOS

TIP As a Word 5.0 for DOS user, I've long been jealous of WordPerfect's ability to easily move files among directories without leaving the program. The unsatisfying workaround in Word was to save the file to another directory, then delete the original. Recently, however, I discovered by accident that Word can move files in one step.

Word 5.0's Transfer Rename command lets you easily change filenames. Simply load the file, choose Escape Transfer Rename, modify the filename, and hit Enter. Less obvious is that you can use the Rename command to modify the path as well as the name itself. If you've loaded the file WHATSIS in the root directory of drive C:, for example, you can move it to the DATA directory by choosing Escape Transfer Rename and changing the filename entry from

```
C:\WHATSIS
```

to

```
C:\DATA\WHATSIS
```

Hit Enter, and Word will move the file to the new directory. If you like, you can change the filename itself at the same time.

James McCollum
Narberth, Pennsylvania

▶**PC MAGAZINE:** Though this capability *is* mentioned in the Word 5.0 manual, the reference is ambiguous at best and easy to miss. Word 5.5 users should also be aware that the 5.5 rename feature has a similar capability that doesn't seem to be mentioned in the manual at all.

In Version 5.0, if you don't know the full pathname that you want to move the file to, you can take advantage of Word's List feature by hitting F1 after giving the Transfer Rename command. You can then move among directories until you get to the one you want. Once there, you can simply type the filename, without the path, and then hit Enter to move the file.

Word 5.0 will not let you move a file if there's already another file by that name in the target directory. Using the List feature also has the benefit of letting you see a list of filenames in the directory before entering the filename to use. Remember, though, that Word will list only those files with a .DOC extension unless you explicitly enter a different choice, such as *.* to match all files, before hitting F1.

You can use the Transfer Rename command to copy a file to another drive, too. When you Rename a file with a different drive letter, however, it's exactly equivalent to saving the file to the second drive. Word does not delete the original file, so you still have to delete it manually in a separate step.

To move a file with the Rename feature in Version 5.5, choose File, File Management. The Rename feature is available as a button in the File Management dialog box. To move a file, simply select it, then choose the Rename button to open the Rename dialog box. Next, ei-

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ther type the path and filename in the To text box and hit Enter, or use the Directories list box to select the target directory for the file, then type just the file name in the To text box and hit Enter. Unlike 5.0, 5.5 will let you overwrite a file of the same name, but it will ask for confirmation first.

You can also move files in Version 5.5 with the Copy option in the File Management dialog box. The copy feature works much like renaming, except that you can tag multiple files first by highlighting one at a time and hitting the Spacebar. You then choose the Copy button to open the Copy dialog box, select the drive and path to copy to, and choose OK. To delete the original files from the starting disk and directory, select the Delete Files After Copy check box before choosing OK.—*M. David Stone*

BACKING UP WINWORD CUSTOMIZATIONS

TIP One of WinWord's most welcome features is the customization it allows. But if one or more customization files become corrupted, the program doesn't help you much. Glossaries, styles, macros, and menus are all stored in templates, with all global versions stored in NORMAL.DOT. WinWord does not automatically back up these files for you—not even keeping one generation back as a .BAK file. If you lose any of your template files, you lose all of the customizations in that file.

Fortunately, it's easy to guard against disaster. Simply create a directory on your disk for the backup files, and use the copy command in DOS, File Manager, or your favorite shell to copy the .DOT files to the backup directory.

Ivri Kumin
Bellevue, Washington

▶**PC MAGAZINE:** The problem is real and this suggestion will work, but it has two shortcomings: First, if you back up to a directory on the same disk, you can still lose all your work if you lose the disk, and, second, you have to remember to back up in the first place.

If you have the luxury of two hard disks, put the backup directory on the second hard disk. Otherwise it's probably a good idea to back up to a floppy disk. To ensure that you don't forget to back up, you can create a global backup macro, name it Autoexit, and WinWord will automatically run it each time you leave the program.

To back up my files, for example, I use a simple two-line Autoexit macro that reads

```
Backup=MsgBox("Back up Files?",
"Back up on Exit",4)
If Backup = -1 Then Shell "command
.com /c c:\batfiles\bu.bat",3
```

(As with all WinWord macros, there is also a Sub MAIN line before these lines and an End Sub line after them.)

The first line creates a message box that asks, Back up Files? and provides Yes and No buttons. The second line evaluates which button you choose. If you choose No, it does nothing. If you choose Yes, it loads COMMAND.COM and runs the batch file BU.BAT in the C:\BATFILES directory. BU.BAT contains several lines that take the form:

```
XCOPY C:\WinWord\*.DOT D:\DOTBUDIR /M
```

This particular line uses XCOPY with the /M switch to copy all modified DOT files from the WinWord directory to the backup directory. Other lines copy all modified files from various data directories to their backup directories. For data directories, you might also want to use the /S switch to copy files from subdirectories under the named directory.
—*M. David Stone*

A PRINTER SELECTION SHORTCUT FOR WORDPERFECT

TIP WordPerfect 5.1 lets you select a printer by typing Shift-F7, choosing Select, highlighting the printer name in the list of currently installed printers, then choosing Select again from the Select Printer screen. The obvious way to highlight the name is with the arrow keys or mouse. But you can also use WordPerfect's Name Search feature, even though the menu on the Select Printer screen doesn't show it as a choice.

Name Search works the same way as it does in the List Files screen and the Select Additional Printers screen. Simply type N for Name Search, then enter the name of the printer. This feature not only eliminates cumbersome cursoring through a long list, but also opens the door to selecting a printer automatically through a macro.

William J. Wolfe
Champaign, Illinois

▶**PC MAGAZINE:** The Name Search feature for selecting a printer is available in WordPerfect 5.0 as well as 5.1 and is mentioned in both 5.0 and 5.1 manuals in the entry for Printer, Select. However, it doesn't show as a menu choice on the Printer Select screen and doesn't seem to be mentioned anywhere in the help screens. So if you're not the kind of person who reads manuals, you would never know about the feature.

When you choose Name Search by typing N, the status line will change to read: (Name Search; Enter or arrows to Exit). You can then enter the printer name. WordPerfect will move the highlight in response to each character, so you only have to enter enough to uniquely identify the printer. Hitting Enter to leave Name Search leaves the highlight at the current position. Using an arrow key leaves Name Search and moves the highlight at the same time. This lets you type a character or two to get close to the name and then use arrow keys to move to the name if you like.

If you use a macro to select a printer, the name search is far preferable: Moving the cursor through the list isn't reliable, since you would get a different printer if the list changed.— *M. David Stone*

Spreadsheets

ENTERING DISTANT VALUES IN FORMULAS

? I regularly use Quattro Pro 4.0 to create large tables, some of which extend to 20 A4 pages on printout. Often I need to add up particular values from these tables—not contiguous ranges of values, but separate items within a table.

It pays to compare.

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When I do this by pointing with the mouse, I move the cursor away from the cell where I'm building my @SUM formula to the table containing the values I want to add. I click on the first value and type a comma, and immediately Quattro Pro takes my cursor back to the cell in which I'm creating the formula. Then I have to "climb" all the way back to the table, find the place where my next value is stored, and repeat the process.

I find this behavior exasperating, particularly when I'm adding values stored on more than a single worksheet. Is there some way to bypass this inefficiency?

Ilan Ben-Josef
Ness-Zionna, Israel

▶PC MAGAZINE: There's no way I know of to do exactly what you want—have the cellpointer stay put when you type that comma and return to the formula cell only when you add the closing parenthesis. But here are a couple of suggestions:

- Name the cells you want to sum. Then, when you build your formula, press F3 to get a list of all defined names on the current sheet. (Press F3 twice if the window that appears isn't large enough to display all your range names.) Instead of pointing to cells, point to their names. That way you'll minimize the loss of context that occurs when you type your commas.
- If that idea doesn't excite you (I know—if your tables are large and you don't know in advance which cells you're going to add, you could spend your whole day assigning range names and you'd need a second computer to help you track which names belonged to which cells), try building your formula in a cell right next to the table. Again, the change of scenery will be less jarring and you'll have less "climbing" to do. When you finish building the formula, use the Move command to put it where it actually belongs.

—*Craig Stinson*

NEGATIVE DATES AND TIMES IN EXCEL

TIP I would like to pass along an interesting Excel tip I recently stumbled upon. I was trying to enter a target time in column A and an actual elapsed time in column B. In column C, I wanted to show the time difference by subtracting column B from column A. I used the *h:mm:ss* display format, and I was getting ########## whenever the time in column B was greater than the time listed in column A.

I figured Excel could not handle negative time (a tough concept for anyone). I began to research this and discovered that time values are decimal serial numbers from 0.00 (12 A.M.) to .999 (11:59:59 P.M.), and that date values are whole serial numbers from 0 (December 31, 1899) to 65380 (December 31, 2078). Therefore, a time of 30 minutes (0:30:00), is treated as 12:30 A.M. or 0.02083333. This was disconcerting because I was only interested in hours, minutes, and seconds, not the time of day. I tried custom number formats and complex formulas only to become more and more frustrated. Out of sheer desperation, I switched from the 1900 to the 1904 date system and voilà! Negative time! I hope other Excel users can find this of value.

I think I know why this works. Since date serial numbers are integers and time serial numbers are fractions, Excel can treat time and date calculations the same way. Let's say you enter a time of 6:00 P.M.; Excel assigns this the value 0.75. Excel looks at the number in front of the decimal—0, in this case—to determine the day. Day 0 of the 1900 date system is December 31, 1899. But day 0 of the 1904 date system is January 1, 1904. If you subtract 1 hour from, say, 12:30 A.M. on December 31, 1899, you come up with a result of 11:30 P.M. on December 30, 1899—a date that Excel can't deal with. If you use the 1904 date system and subtract 1 hour from 12:30 A.M. on January 1, 1904, you get 11:30 P.M., December 31, 1903, a date that Excel can deal with—and Excel displays this as a negative value, because it is before the base date of the 1904 date system.

Edward L. Burwell
Belleville, New Jersey

▶PC MAGAZINE: Mr. Burwell has hit upon an original solution to a commonplace problem. Time arithmetic, unlike date arithmetic, is often a slippery proposition in spreadsheet programs. The programs' time formats are best suited for representing points in time, not quantities or intervals of time. Usually, when one wants to display and perform calculations on quantities of time (hours worked, for example), one first converts the inputs to multiples of a single unit—days, hours, minutes, or seconds. Mr. Burwell would have had no problem with his addition and subtraction had he been content to store half an hour as 30.0, an hour and a quarter as 75.0, and so on.

But for Mr. Burwell's application, it was apparently handy to be able to enter time quantities into the spreadsheet exactly as they appeared on the stopwatch. You can do that in Excel, but Excel will assume you mean a particular moment on a particular day, not a quantity of hours, minutes, or seconds. The entry 0:30:00 will be regarded as exactly 30 minutes past midnight on the system's base date, which—in the Windows version of Excel—is normally December 31, 1899. (To be more precise, the default base date is actually the 0th of January, 1900; try formatting 0 as m/d/yy to see what I mean.)

If you subtract a larger time, so entered, from a smaller one, Excel cannot display the result in any of its date or time formats, because those formats are incapable of displaying anything earlier than the base date. Thus you get the annoying cell full of pound signs that refuse to go away no matter how wide you make the column. (One might wish that Excel had a different symbol to represent a quantity that is inherently undisplayable, as opposed to one that is merely too wide for the column. But it doesn't.) The subtraction is performed and the correct result is stored internally, but Excel can't show you the outcome in the format it assumes you desire. If you subtract 0:45:00 from 0:30:00 and change the result cell's format to General, you get a perfectly displayable -0.01042.

Had Mr. Burwell wanted to, he could have multiplied all his result cells, including those full of pound signs, by 24*60 (the number of minutes in a day) and come up with ordinary numbers representing the variances as minutes with decimal fractions. But he wanted to see the variances in the same stopwatch format used for his inputs.

The following formula would have ac-

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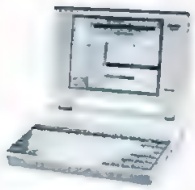

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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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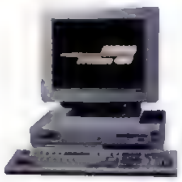

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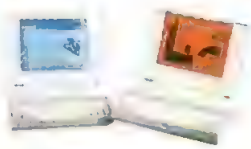

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complished the same thing:

```
=IF(ISERROR(TEXT(A3-
B3,"h:mm:ss'')),"-"&TEXT(B3-
A3,"h:mm:ss'') ,TEXT(A3-
B3,"h:mm:ss''))
```

But in addition to being a pain to implement, this "solution" has the disadvantage of leaving you with text instead of numbers. If you wanted to sum or average your variances, you'd be out of luck.

Mr. Burwell's solution is both elegant and a little bizarre. Excel provides the alternative base date of January 1, 1904 (it truly is January 1, 1904, not January 0, 1904, or December 31, 1903), because the original Macintosh version of Excel used that base date. Microsoft switched bases for the first Windows version of Excel so that it would be compatible with Lotus 1-2-3, which uses December 31, 1899, as its base date. The "1904 Date System" option, which appears in the Options Calculation dialog box, simplifies the exchange of files with users of Macintosh Excel. Unlike the default dating system, it also allows the time- and date-formatted display of negative values.

The 1904 date system, in fact, seems well suited to representing both time quantities and moments in time. Display -1000 in *mmmm/d/yy* format with this option on, for example, and you get -September 27, 1906—which must have been a very negative day.

If you use Mr. Burwell's discovery, use it consistently. Decide which base date you want before you begin setting up a worksheet, and all will be well. Entering 1/18/93 will get you January 18, 1993, regardless of which date system is in effect. But if you change to another system after you have put data on the sheet, your dates will change as well.—*Craig Stinson*

Databases

MULTIPLE SELECTION PICK LISTS IN FOXPRO

TIP FoxPro's Browse window is an extremely powerful tool for viewing and updating tables. I've developed a technique that uses a Browse window to display a multiple selection pick list. The user checks or unchecks selections by pressing the Spacebar.

You begin by creating a temporary table that contains the information that you want to appear in the pick list, and two additional fields as well: a one-character field called Check, and a logical field called Select. For a pick list containing names and addresses, for example, you might use the following:

```
SELECT " " as Check,
.F. as Select,
Name, Address FROM Cust
INTO TABLE Temp
```

You then replace the Check field with CHR(255) throughout in the temporary table:

```
REPLACE ALL Check
WITH CHR(255)
```

This value will display as blank, giving the impression that no record has been selected, but since it is not actually a space, FoxPro will execute the function attached to the Check column when you press the Spacebar. Next, you open the Browse window:

```
BROWSE FIELDS Check:h='Select'
:v=CKVALID(), Name:w=.F.,
Address:w=.F.
```

When the user presses the Spacebar, the CKVALID routine is called. If the Check field is blank, it is replaced with CHR(251)—a check mark character—and the Select field is set to true. If the Check field is already set to a check mark, it is set to a space, and the Select field is set to false. In this way, pressing the Spacebar acts as a toggle.

The VALID function follows:

```
FUNCTION ckvalid
IF EMPTY(Check)
REPLACE Select WITH !Select,
Check WITH
IIF(Select,CHR(251),CHR(255))
RETURN .T.
ENDIF
RETURN .F.
```

Note that when the Browse window is opened, the other fields besides Check are prohibited from receiving the cursor (using :w). As a result, the cursor is not allowed to leave the Check field.

Robert Ching
San Francisco, California

▶**PC MAGAZINE:** Mr. Ching's technique is similar to a number of others I've seen, all designed to use FoxPro's Browse window to provide the user with a multiple selection pick list. The basic logic—using a temporary table that contains a check mark column, and calling a special check mark routine whenever the user presses the trigger key (in this case the Spacebar), is common to many of the techniques.

In the approach shown above, the cursor is placed in the Check field in the Browse window and the user can then press the Spacebar to select records. Whenever the Spacebar is pressed, FoxPro sets the Check field to a space and then calls the VALID function that is attached to the Check field (the one specified with :v in the BROWSE command). Note that the Check field is initialized at the start to CHR(255) because FoxPro will only call the VALID routine if the field's value is actually changed. Had the Check field been initialized to a space instead of CHR(255), pressing Spacebar wouldn't cause the field's value to change (since it was already a space), and the VALID routine would not be called.

When the VALID routine gets control, the previous value of the Check field has been lost (you typed a space over it), making it impossible to decide from the Check field alone whether the field should be toggled on (checked) or off (unchecked). Therefore, Mr. Ching employs the second logical field to maintain the true status of the check field. A logical field is a natural for a toggle indicator, since its value can easily be reversed using the ! operator (as in !Select).

The disadvantage of Mr. Ching's approach is that it requires two extra fields and does not let the user pan across the Browse window horizontally. The advantage is that it eliminates the use of an ON KEY LABEL hotkey, which is required by other techniques.

One alternative approach is shown in the BROWPICK function in Figure 1.

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BROWPICK.PRG

Complete Listing

```
*****************************************************************
* BROWPICK.PRG - Demonstrate use of the BROWPICK function.
*****************************************************************
SET ECHO OFF
SET TALK OFF
CLEAR
SET SYSMENU OFF
pcmag="PC Magazine Databases PC Magazine Databases PC Magazine Data"+;
      "bases PC Magazine "
@ 0, 0, 24, 79 BOX
FOR i = 1 TO 23
   @ i, 1 SAY pcmag
ENDFOR
* All fields
USE C:\FOXPROW\BKINV
cTable = BROWPICK( DBF(), "Book Catalog-All Titles")
IF "" <> cTable
  CLEAR
  LIST FIELDS Title, Pubdate
  USE
  DELETE FILE (cTable)
ENDIF
WAIT
CLEAR
@ 0, 0, 24, 79 BOX
FOR i = 1 TO 23
   @ i, 1 SAY pcmag
ENDFOR
* Selected fields and where clause
SELECT Bkinv
cTable = BROWPICK( DBF(), "Book Catalog-Selected Titles", ;
  "Title, Pubdate", "Pubid=='000001'")
IF "" <> cTable
  CLEAR
  LIST FIELDS Title, Pubdate
  USE
  DELETE FILE (cTable)
ENDIF
CLOSE ALL
RETURN

*****************************************************************
* FUNCTION BROWPICK - Browse a table as a pick list and allow multiple
* selections. Press Spacebar to toggle selections. Press Enter or
* Ctrl+W to terminate the Browse window.
*
* Call with arguments: Table/DBF name, title for the Browse
* window, optional field list, optional WHERE clause
*
* Returns name of temporary table containing the selected records, or
* empty string if Esc is pressed. Note that table may be empty if
* Enter is pressed without making any selections.
*
* If a table name is returned it is the callers responsibility to
* erase the temporary table when you're done with it.
*****************************************************************
FUNCTION BROWPICK
PARAMETER cTbl, cTitle, cFieldlist, cWhere
PRIVATE cTmp
cOldBell = SET("BELL")
SET BELL OFF
IF EMPTY(cFieldlist)
  cFieldlist = '*'
ENDIF
IF EMPTY(cWhere)
  SELECT " " AS Check, &cFieldlist FROM (cTbl) INTO TABLE SYS(3)
ELSE
  SELECT " " AS Check, &cFieldlist FROM (cTbl) WHERE &cWhere ;
  INTO TABLE SYS(3)
ENDIF
ON KEY LABEL SPACEBAR DO CHKMARK
ON KEY LABEL ENTER KEYBOARD CHR(23)
cSchemel = SCHEME(1)
SET COLOR OF SCHEME 1 TO SCHEME 10
@ SROWS()-1, 7 SAY "Press Spacebar to toggle selection, Enter to " + ;
 "finish, Esc to cancel"
SET COLOR OF SCHEME 1 TO &cSchemel
DEFINE WINDOW BROWPICK FROM 3, 6 TO 21, 73 COLOR SCHEME 10
BROWSE NOMODIFY NOMENU NOAPPEND NODELETE TITLE cTitle WINDOW BROWPICK
RELEASE WINDOW BROWPICK
ON KEY LABEL SPACEBAR
ON KEY LABEL ENTER
SET BELL &cOldBell
@ SROWS()-1, 5
IF LASTKEY()==27
  cTmp=DBF()
  USE
  DELETE FILE (cTmp)
ELSE
  DELETE ALL FOR Check <> CHR(251)
  PACK
ENDIF
RETURN DBF()

*****************************************************************
* PROCEDURE CHKMARK
* Toggle the selection marker on the current record, refresh the
* Browse window display.
*****************************************************************
PROCEDURE CHKMARK
REPLACE Check WITH IIF(Check=" ", CHR(251), " ")
SHOW WINDOW (WONTOP()) REFRESH
RETURN
```

Figure 1: **The BROWPICK function can be used to display a table as a multiple selection pick list. The user can check or uncheck records to make selections.**

Here, instead of using the VALID function in the Browse window to check and uncheck records, an ON KEY LABEL command is used to bind the CHKMARK routine to the Spacebar key. Once an ON KEY LABEL is active, FoxPro calls the associated routine whenever the specified key is pressed. This means that the CHKMARK routine is called independently, not as part of Browse window editing. Since the Check field is not altered directly within the Browse window, its previous value isn't lost before the CHKMARK routine is called, and the routine can determine for itself whether to check or uncheck the field. The need for a second field has been eliminated.

To use the BROWPICK routine, you call it with the name of the table to display as the pick list, and a title to place in the title portion of the Browse window. After the user has finished making selections, he or she presses the Enter key and the routine returns the name of a temporary table containing the records that were selected. It's important that you remember to delete the table when you're finished using it.

The function works by using the SQL SELECT command to copy the source table information into a temporary table that also contains the Check field. The Check field is initialized to a space throughout, and the CHKMARK routine is bound to the Spacebar key. Then the Browse window is opened in read-only mode. You can move up, down, left, and right within the Browse window and you can press the Spacebar to check and uncheck records. When you press the Spacebar, our CHKMARK procedure is called to do the checking and unchecking. When you're finished selecting records, press the Enter key. Records that weren't selected are deleted from the temporary table and the table name is returned to the calling routine.

Note that if you leave by pressing Esc instead, the temporary table is deleted and BROWPICK returns a Null string, which the caller must detect. Also be aware that the temporary table will be empty if you press Enter without selecting any records. Of course, it is the caller's responsibility to delete the temporary table at some point.

The BROWPICK routine is useful as a general black-box pick list routine, since all you have to do is give it a table name and a title. However, when used this way it makes a copy of your entire source table, using up lots of disk space

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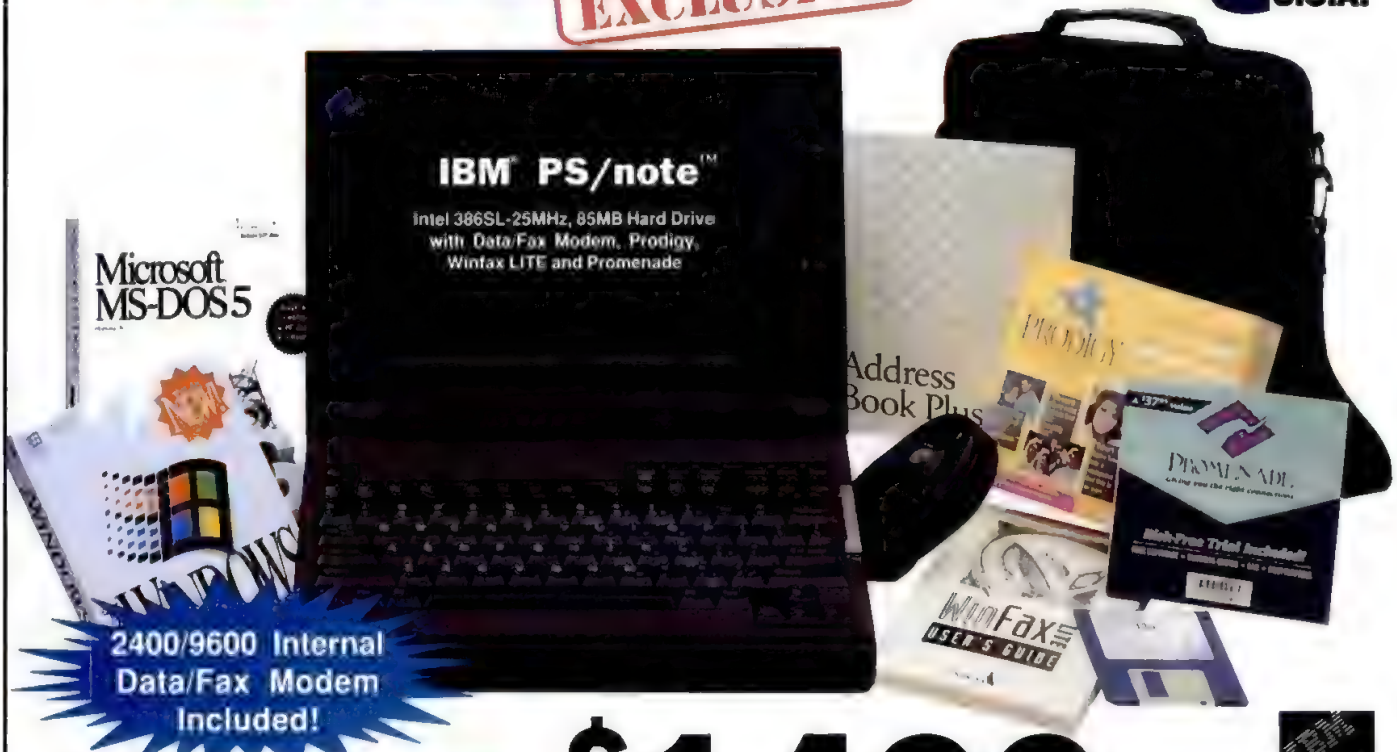

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Provides 32-bit wide path that runs at the speed of the CPU. Achieve a maximum transfer rate of 132MB/sec.

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32-Bit Power Plus VESA Speed

Window Accelerator from BOCA with "True Color" Video

The FLEXVISION Monitor by MAG Innovision Inc.

VESA Standard 72Hz Refresh Rate for "Flicker Free" Images

You won't find a better value in a 14" SVGA non-interlaced monitor. Manufactured for USA FLEX by Mag Innovision Inc.—whose monitors have won the prestigious PC Magazine Editor's Choice award in each of the last three years. The FLEXVISION provides sharp flicker-free images at even the highest resolutions.

PC MAGAZINE PC MAGAZINE PC MAGAZINE

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intel inside

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- VESA 32-Bit Local Bus IDE Controller
- 4 MB RAM Expandable to 32 MB
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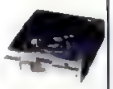
Whisper Quiet Floppy Drives From SONY & TEAC



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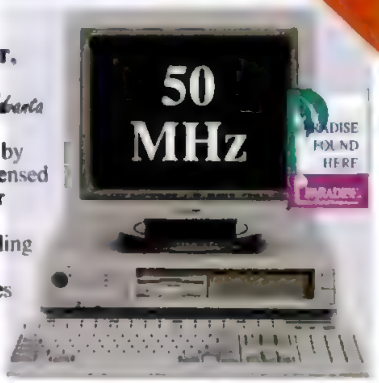

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At the heart of the FLEX *Advanta* Workstation is a unique motherboard manufactured by IBM and using the Intel licensed 486SLC2 50MHz processor incorporating larger 4-way, 16K Cache and clock-doubling technology. The FLEX *Advanta* Workstation provides high performance and speed at an unbelievably low cost.

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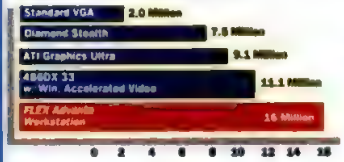

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EPL-8000 - 10 ppm, 14 fonts, 300 dpi, 1MB $829

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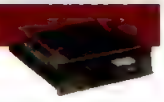

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in the process. This limits its usefulness to reasonably small tables. To reduce the disk space requirements, you can pass the routine two additional optional parameters: a comma-separated field list and a WHERE clause for the SELECT command. The field list restricts the temporary table to only those fields that you select. The WHERE clause restricts the temporary table to only those records that satisfy the WHERE condition. An example of this usage is shown in the code listing in Figure 1.

The code shown in Figure 1 is available on PC MagNet. Look for BROPIK.PRG in the Utilities/Tips Forum.—*Sal Ricciardi*

Graphics

INEXPENSIVE MAPPING

❓ I draft maps consisting of simple line drawings that can be filled based on geographical coordinates—latitude and longitude or north/south directions. For example, a deed that describes a piece of property (known as a parcel map or plot plan) typically gives the location of a starting point, expressing subsequent coordinates as a combination of direction (in degrees) and distance (in feet or miles) from the start or from the previous mark. I also draw aeronautical, boat navigation, and off-road vehicle charts.

I've been unable to locate an inexpensive CAD program that can handle these functions without requiring a lot of money for add-on modules or extra work. Can you direct me to a source?

Art Sommer
Fallon, Nevada

▶**PC MAGAZINE:** If price is an issue, consider EasyCAD from Evolution Computing (800-874-4028). The product lists for only $199 but—like more expensive packages—allows you to use Relative Polar Coordinates in which you create a new point by entering its displacement (given as an angle and a distance) from the previous point).

More sophisticated mapping and surveying functions require third-party programs that tend, as with all specialized software, to come down a tad on the expensive side. But the additional dollars buy you tools that perfectly match the work you do.

Altos from Armasi Corp. (800-848-2955) works in conjunction with EasyCAD and handles the tasks associated with parcel maps, such as the insertion of parcel numbers into each lot. More important, the program can fill outline drawings or polygons in order to generate area maps for land use analysis. Altos sells for $349, but Armasi offers a low-cost bundle with EasyCAD that costs only $399.

For $595 you can purchase the Techmac Surveying and Graphics Program from Technical Advisers (800-521-9958). Techmac lets you create drawings from scratch using true geographic coordinates: latitude and longitude. It exports the EasyCAD/FastCAD format (.FCD), making it an ideal EasyCAD companion. In fact, the product also exports AutoCAD's Data Exchange Format (.DXF) and Hewlett-Packard's Graphics Language (HPGL), which are standard file formats that can be used with almost any CAD program on the market.
—*Luisa Simone*

HANDCRAFTED CROP MARKS

❓ I use CorelDRAW to generate flyers and envelope stuffers. I print the designs on my HP LaserJet III, duplicate them with a copy machine, then trim them on an ordinary paper cutter. This little in-house production system works fine—except I'm forced to add crop marks manually. Is there any easy way to add crop marks in CorelDRAW?

Barry Pendelton
Rochester, New York

▶**PC MAGAZINE:** There's a very easy way to add crop marks in CorelDRAW; unfortunately, it may not work for you. CorelDRAW's print dialog box changes depending on whether you're printing to a PostScript device or to a non-PostScript (that is, PCL) device. Only the PostScript options include crop marks. If you must print to a PCL device, such as the HP LaserJet II, you'll have to add the crop marks manually.

This isn't as bad as it sounds. You can use guidelines (which are pulled from the vertical and horizontal rulers) to be sure that the crop marks are properly aligned with the edge of the page. And don't worry about placing the crop marks outside of the page boundary, because CorelDRAW will print any object that appears on the pasteboard. But you must be sure that both the custom page and the crop marks fall within your printer's imaging area, and that they fit on the paper.

Here's a little trick that can help you add trim marks to a document. Start a new document. On the File menu invoke the Page Setup dialog box, then choose paper orientation, and type in a Custom Page size. Before leaving the dialog, click on the Add Page Frame button. When you select this option, CorelDRAW creates a rectangle that is the same size as the page, assigns the default line and fill attributes, and places the rectangle behind all of the other objects on the page. To make the page frame useful as a trimming guide, go to the drawing screen and format the rectangle with no fill, and a line pattern of dots or dashes. While this isn't the most elegant solution, it is quick and will give you sufficient guidance when you trim your printouts.

If you draw crop marks manually, you should remember that they're just ordinary objects that can be edited, moved, or deleted. You can avoid accidental changes to your crop marks by moving them to a discrete layer and then locking that layer. Here's how.

First open Corel's layer manager window—called the Layer Roll-up—from the Arrange menu. Click on the right-pointing arrow and select New. Give the new layer a meaningful name, for example, "crop marks." Now return to the drawing layer. Select the objects you're using as trimming guidelines, either crop marks or the Page Frame bounding rectangle. In the Layer Roll-up, click on the right-pointing arrow and select Move To, then select the target layer. Corel will move the object to the layer that you've specified. Locking the layer that contains your crop marks is as simple as clicking on the right-pointing arrow and then choosing Edit. In the Layer Options dialog box, check the Locked option and make sure that the Printable option is also active.—*Luisa Simone*

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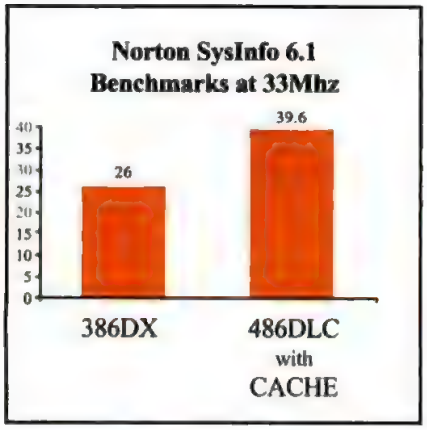

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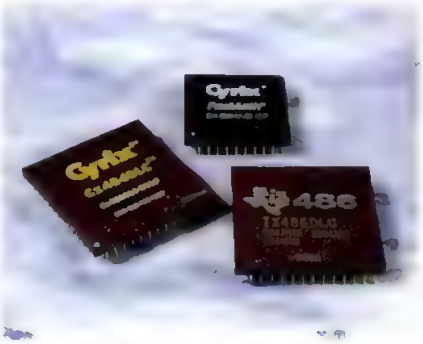

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Networking

MODEM SHARING

❓ We run a 20-node NetWare network and would like to be able to share a 14.4-kilobit-per-second modem over it. Do we need a separate PC for a communications server? What about additional software to share the modem? Can I use some type of peer-to-peer networking product and attach the modem to one of its nodes?

Frank Bruno
New York, New York

▶**PC MAGAZINE:** Sharing modems for outgoing calls is a good way to cut down on the expense of telephone lines, but peer-to-peer networks can't provide modem sharing because DOS communications programs typically address the serial port hardware directly rather than rely on slow DOS function calls. Since the network redirector is only aware of requests that an application makes to DOS, it can't reroute the typical communication utility's actions over the network.

Fortunately, companies such as Microtest, Shiva Corp., and UDS have made modem sharing easy by offering fast V.32bis networked modems combined with an appropriate LAN adapter. They also supply the software you need to carry the data between the communications program and the shared modem. However, you'll have to make sure that the program each client PC uses can address interrupt 14. This is a standard for across-the-LAN modem communications, and almost all current releases of communications programs support it.

For more information on these products, see the feature "Dialing in at Large" in the October 27, 1992, issue of *PC Magazine*. And take a look at "Sorting Out Remote Access Options" in the April 28, 1992, Connectivity column; though things have evolved since it was written, it still provides good background on modem sharing.—*Frank J. Derfler, Jr.*

SAVING SPACE

❓ We have five PCs acting as servers in our computer room. After adding new wiring hubs, we've run out of space. We could put the PCs in cabinets, but then they'd be inconvenient to use. Is there a good way to rack-mount the PCs with the wiring hubs?

Mike Hoffman
Arlington, Texas

▶**PC MAGAZINE:** A company called Morton Management (301-622-5600) offers a wide range of rack-mounting options aimed at network servers. The basic product, called GigaRak, is a standard 19-inch cabinet with two built-in monitors and a UPS. You can add many other drawers and devices including a rack-mounted IBM Model 95 PS/2 server that Morton Management makes under an agreement with IBM. Prices for the products start at about $4,000.
—*Frank J. Derfler, Jr.*

BETTER NETWORK THROUGHPUT

❓ In the feature story "Token-Ring Adapters for the PC: Poised for an Explosion," published in the October 13, 1992, issue, you described the benefits of putting more than one adapter in a server to increase its network data-carrying capability. Does this work with Ethernet also? What about a product like the Kalpana EtherSwitch? Will that increase throughput too?

Doug Chisom
Orlando, Florida

▶**PC MAGAZINE:** Modern servers with high-speed processors and large disk caches can deliver data at a faster sustained rate than either a single Token-Ring or Ethernet adapter can accept, so the network adapter becomes a bottleneck. One solution is to divide the network cable system into separate segments and connect the server to each segment through a separate LAN adapter. This technique works for both Token-Ring and Ethernet. There are some drawbacks because the server must act as a router to link the LAN segments, but it's still a good approach, particularly for a NetWare network because of NetWare's excellent internal router. Segmenting the network in this way also improves overall reliability. A cable or adapter problem on one segment doesn't stop operation on the others.

The situation becomes more complex, though, if you introduce multiple servers into the network. Even if you give every server its own attachment to each LAN segment, the servers still spend a lot of time waiting for access to the cable. This is where a device such as the Kalpana EtherSwitch works best. The EtherSwitch serves as a communications "front-end processor" for the servers and routes the appropriate traffic to each one. Each server sees a relatively quiet LAN cable with much less contention. The EtherSwitch directs the outgoing data to the appropriate LAN segment without generating traffic on the other segments.

The bottom line? Multiple adapters work well in a single busy server, while an EtherSwitch functions best directing traffic among network segments and several busy servers. Contact Kalpana at 408-428-1150 for details.
—*Frank J. Derfler, Jr.*

SPURIOUS NUMBERS

❓ We have a puzzling situation. When networking software is loaded, the keyboards on some of our PCs generate spurious numbers. This seems to happen only when we're running a spreadsheet program, but we can't seem to find any common factor.

Brian Dillingham
Dallas, Texas

▶**PC MAGAZINE:** Network vendors are *very* familiar with this problem. In some PCs with some BIOS chips, the extended function (101-key) keyboards seem to automatically switch into shifted mode. Shifted key values are entered even when the Shift or CapsLock keys are not hit, and hitting the Shift key might or might not restore the unshifted mode. This isn't the fault of the networking software, but since the software brings out the problem, LAN vendors get the blame.

The problem occurs when the PC's internal timing is upset by the CPU processing interrupts from memory management or networking software. The delay causes some CMOS chips to stumble and generate a keyboard data overrun. Your first step should be to check with the

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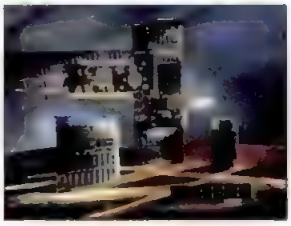

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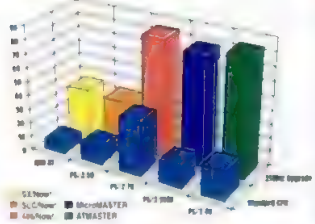

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manufacturer of the PC or the motherboard for a fix. For example, AMI has a retrofit for some early motherboards. An easier alternative, however, is simply to make sure you have the latest version of all memory management programs and network drivers. The vendors of these programs are aware of this problem and have written their code to avoid it.—*Frank J. Derfler, Jr.*

Languages

ACCESS WINDOWS SERVICES FROM DOS BASIC

TIP How can you tell if your DOS program is running under Windows? How can you make your application Windows-friendly? How can you prevent your program from being swapped out to disk while executing a critical section of code? These are questions many DOS programmers have faced.

Windows allows a number of interrupt services for DOS programs running under Windows' Enhanced mode. These services, though sparse, give your DOS programs some control over their interaction with Windows. I have written five routines that provide access to the DPMI (DOS protected-mode interface) services, which are available under Windows (see Figure 2).

The first function is *WindowsActive*, and it determines whether you are running under Windows in its 386 Enhanced mode, Standard mode, or under the DOS Shell. This function calls the Multiplex interrupt, &H2F, function &H1600. If AX is returned with a value other than 0, &H80, or the service number of &H1600, then Windows 386 Enhanced mode is active. In this case the version of Windows is returned in AX. The function converts that value into a displayable form and returns it in the variable Ver! (an example would be 3.1, for Windows, Version 3.1).

If Windows Enhanced mode is not running, then WindowsActive calls interrupt &H2F service &H4B02 to check for the presence of the task switcher. The address for the task switcher is returned in ES and DI; if they are nonzero, the task switcher is loaded. Note that Windows 3.1 Standard mode uses the same implementation as the DOS 5.0 Shell. So in order to determine whether the DOS Shell or Windows in Standard mode is loaded, WindowsActive looks for the existence of the environment variable named "windir" (note the lowercase text). If this variable is present, then Windows is running in Standard mode; otherwise the DOS Shell is loaded.

WindowsActive returns one of four values as follows:

- -1 Windows 386 Enhanced mode is active, and the version is returned in Ver!.
- 1 The DOS Shell is active.
- 2 Windows Standard mode is active.
- 0 None of the above: neither Windows nor the DOS Shell is active.

The second function is *GetCurrentWindowsVM*; it determines which in-

WINFUNCS.BAS

Complete Listing

```
'********** WINFUNCS.BAS - Harry F. Harrison

DEFINT A-Z
'$INCLUDE: 'QB.BI'    'use QBX.BI with PDS, or VBDOS.BI with VB/DOS

DECLARE FUNCTION WindowsActive% (Ver!)
DECLARE FUNCTION GetCurrentWindowsVM% ()

SELECT CASE WindowsActive%(Ver!)
  CASE 0:  PRINT "Neither Windows nor DOS Shell are active"
  CASE -1: PRINT "Windows 386 Enhanced mode is active, ";
           PRINT USING "Version #.##"; Ver!
  CASE 1:  PRINT "DOS Shell is active"
  CASE 2:  PRINT "Windows Standard Mode is active"
END SELECT

PRINT "Windows Virtual Machine ID #:"; GetCurrentWindowsVM%

'END OF DEMO

SUB EndCriticalCode

  'Reenables Windows swapping after a call to StartCriticalCode.
  DIM InRegsX AS RegTypeX, OutRegsX AS RegTypeX
  InRegsX.AX = &H1682
  CALL InterruptX(&H2F, InRegsX, OutRegsX)

END SUB

FUNCTION GetCurrentWindowsVM%

  'Gets the current Virtual Machine ID under Windows.
  DIM InRegsX AS RegTypeX, OutRegsX AS RegTypeX
  InRegsX.AX = &H1683
  CALL InterruptX(&H2F, InRegsX, OutRegsX)
  GetCurrentWindowsVM% = OutRegsX.bx

END FUNCTION

SUB GiveUpTimeSlice

  'Gives up the remainder of a time slice to Windows.
  DIM InRegsX AS RegTypeX, OutRegsX AS RegTypeX
  InRegsX.AX = &H1680
  CALL InterruptX(&H2F, InRegsX, OutRegsX)

END SUB

SUB StartCriticalCode

  'Prevents Windows from swapping out.
  DIM InRegsX AS RegTypeX, OutRegsX AS RegTypeX
  InRegsX.AX = &H1681
  CALL InterruptX(&H2F, InRegsX, OutRegsX)

END SUB

FUNCTION WindowsActive% (Ver!)

  'determines whether Windows is Active and if so which version.

  DIM InRegsX AS RegTypeX, OutRegsX AS RegTypeX
  InRegsX.AX = &H1600
  CALL InterruptX(&H2F, InRegsX, OutRegsX)

  IF (OutRegsX.AX AND &HFF <> 0) AND (OutRegsX.AX AND &HFF <> &H80)
AND (OutRegsX.AX <> &H1600) THEN
     WindowsActive% = -1
     Ver! = (((OutRegsX.AX AND &HFF) * 100) + OutRegsX.AX \ 256) / 100
  ELSE
     InRegsX.bx = 0
     InRegsX.di = 0
     InRegsX.es = 0
     InRegsX.AX = &H4B02
     CALL InterruptX(&H2F, InRegsX, OutRegsX)
     IF OutRegsX.es OR OutRegsX.di THEN
    WindowsActive% = 1
     END IF
     IF LEN(ENVIRON$("windir")) THEN
    WindowsActive% = 2
     END IF
  END IF

END FUNCTION
```

Figure 2: **This program contains five procedures and a short demonstration showing how to access Windows services from a BASIC program by using the Multiplex interrupt.**

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stance of DOS the program is running under. Since Windows' 386 Enhanced mode runs in protected mode and is able to create *virtual machines*, it allows the PC to run multiple DOS sessions. Each session is assigned a unique ID number, which GetCurrentWindowsVM returns. One possible use of this function is to create unique filenames when multiple copies of the same DOS program are running. Note that the process ID numbers are reused when DOS windows are closed, and that the Windows kernel is always assigned ID #1.

If you want to make your programs multitasker-friendly, you should yield CPU time when your program doesn't need it. For example, many programs spend much of their time waiting for input from the keyboard. This is where the *GiveUpTimeSlice* subprogram can help. If you add this call to a keyboard input routine that waits in a loop for keypresses, system performance will improve. GiveUpTimeSlice works with both Windows and OS/2. The system immediately returns to the calling program if there are no other tasks needing CPU time.

The final pair of subprograms lets you tell Windows that you are performing a time-critical operation, such as updating a file, that should not be interrupted. You would therefore call *StartCriticalCode* before beginning that part of your program, and then call *EndCriticalCode* when you are finished. Between these calls, you are assured that Windows will not switch to another task or swap your program temporarily to disk.

Harry F. Harrison
Portland, Oregon

▶PC MAGAZINE: These routines use BASIC's CALL INTERRUPT routine, so you must tell BASIC to load its support library by starting it with the /L switch. For QuickBASIC users, this loads the QB.QLB file; if you have BASIC PDS, the file is named QBX.QLB; and in VB/DOS, it is called VBDOS.QLB. Likewise, when you are compiling and linking these programs manually from the DOS command line, you must tell LINK to use the appropriate library file. The names are QB.LIB, QBX.LIB, and VBDOS.LIB for use with QuickBASIC, BASIC PDS, and VB/DOS, respectively.

To add these functions to your own programs, you should remove the demonstration portion of the code: Just delete all of the lines beginning with the SELECT CASE line through the "End of demo" comment. You can download WINFUNCS.BAS as the file WINFUN.BAS from PC MagNet's Programming Forum.—*Ethan Winer*

C SHORTCUTS AND THE DAY OF THE WEEK

TIP I've recently written a program, DOWGJ.C, that computes the day of the week for any date in the years 0 through 9999 in either the Gregorian or the Julian calendar. If nothing else, it illustrates the use of some of the C language operators, especially the conditional operator (? :).

To use it, simply enter a date in *mm dd yyyy* format and DOWGJ will print the day of the week on which that date falls in the Gregorian calendar. To compute a day on the Julian calendar, enter any extra argument after the required Month Day Year values.

The function DOW returns the remainder of the total number of days from 1/1/0000 to the date given divided by 7, which is the offset to the DOWSTR array of strings for the day of the week used by the main function when printing the result.

To compute the day of the week, DOW must take into account the "Gregorian leap year rule." By this rule a centesimal year (ending in 00) whose number cannot be divided by 400 is not a leap year; therefore, years such as 1800 and 1900 in the Gregorian calendar are not leap years, but 2000 is.

I like DOWGJ because of its compactness. It's also a good tool for finding out interesting things. For example, I found that the day of the week when Columbus discovered the New World (DOWGJ 10 12 1492 J) was on a Friday (Julian calendar); the last day of the Julian calendar in the American colonies (DOWGJ 9 2 1752 J) was on a Wednesday; and the first day of the Gregorian calendar (DOWGJ 9 14 1752) was Thursday, of course.

Roberto R. Viscogliosi
Daly City, California

▶PC MAGAZINE: Determining the day of the week is one of those problems that is both interesting to solve and likely to result in a useful program. The algorithms for determining the day of the week for both the original Roman calendar (Julian) and its refined 1.1 version (Gregorian) are included in Mr. Viscogliosi's program, shown in Figure 3. The real work of the program is done by the DOW routine, which returns the day of the week as a value from 0 to 6. Before I examine the DOW function, however, a review of some of the C language constructs would be helpful.

C is a flexible, powerful language. One of the more interesting tools in its repertoire is the conditional operator `?:`, which can be thought of as a short form of the `if` statement. In C, the value of the conditional statement can assume one of two values depending on a logical condition. The logical condition is placed before the `?` followed by the value if the condition is true (the "then" part), the colon, and finally the value if the condition is false (the "else" part.) The statement is written in the form:

```
(logical condition) ?
(value if true) : (value if false);
```

For example, if you want to set `x` to the larger value of `y` or `z`, an `if` statement would look like:

```
if (y > z)
   x = y;
else
   x = z;
```

The conditional operator compresses this logic into the following one-line statement:

```
x = (y > z) ? y : z;
```

Many C programmers like the conditional operator because of its compactness: Instead of four lines to make the assignment, you can do it in one.

Mr. Viscogliosi uses another interesting characteristic of the C language—that relational expressions have numeric values instead of a true or false Boolean value. The reason for this is that C does not have an explicit Boolean data type.

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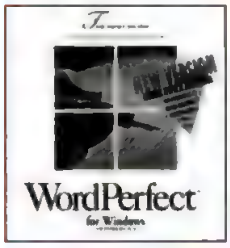

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Relational operators such as == (equal), != (not equal), > (greater than), and < (less than) return the integer value 1 if the condition is true and 0 if the condition is false.

For example, an expression that tests to see whether the number 10 is greater than 9,

```
(10 > 9)
```

has an integer value of 1, while the expression,

```
(9 > 10)
```

has a value of 0. Since the result is an integer, it can be directly assigned to other numbers. For example, to increment the variable x if y is greater than z, the statement

```
x += (y > z);
```

can be used. For anyone unfamiliar with C, I have used another shortened operator +=, which is the same as writing

```
x = x + (y > z);
```

Mr. Viscogliosi has used both the conditional operator statement and the trick with relational operators producing numeric values to achieve what has become the Holy Grail of dedicated C programmers, the proverbial one-line function. While the function has been split into separate lines for formatting purposes, the DOW function can actually be compressed into one line of over 200 characters.

Since one-line functions are at least as much of a challenge to read as they are to write, I have rewritten the DOW routine as a multiline function, which is somewhat easier to understand. In

DOWGJ.C

Complete Listing

```
/*****************************************************************
  DOWGJ -  Day_Of_the_Week Gregorian or Julian calendar
*****************************************************************

  Author: Roberto R. Viscogliosi
  Date Written : 10/92
  Release: 1.1

  This program computes the Day_Of_the_Week for a given date using
  the Gregorian calendar as default, or the Julian calendar when an
  extra argument is given at the command line.

  Input Arguments:
      mm dd yyyy [c]
      where:
         mm = month,  dd = day,  yyyy = year
        [c] = any value forces the use of the Julian calendar;
               no value uses the Gregorian calendar.

  Example:DOWGJ 10 12 1492 j
       Last change:  14 Jan 93       2:30 pm
*****************************************************************/

#include <stdlib.h>
#include <stdio.h>

#define  OK   0
#define  GRG  1

long dow (int, int, int, int);
void help (char *);

//===============================================================
// MAIN process
//===============================================================
int main (ac, av)
int ac;
char *av[];
{
   int day, month, year, calendar = GRG, ret = OK;

   static char *dowstr[7] = {
      "Sunday", "Monday", "Tuesday", "Wednesday",
      "Thursday", "Friday", "Saturday"
   };

   for (;;) {
      // check arguments passed
      if  (ac < 4) {          // not enough args.
          ret = !OK;
          break;
      }
      // get/verify the input values
      if  (((month = atoi (av[1])) < 1) ||
           ((day   = atoi (av[2])) < 1) ||
           ((year  = atoi (av[3])) < 1)
          ) {                 // invalid values
          ret = !OK;
          break;
      }
      // check if Julian calendar requested
      if  (ac > 4) {          // reset the calendar indicator
          calendar = !GRG;
      }
      // prevent overflow by check year size
      if  (year > 9999) {     // year too large
          ret = !OK;
          break;
      }
      // compute and show the day_of_the_week
      printf ("%02d/%02d/%04d is on %s %s\n",
               month, day, year,
               dowstr [dow (month, day, year, calendar)],
               (calendar == GRG) ? "" : "(Julian calendar)"
             );
      break;
   }
   // check for errors
   if  (ret) {
       help (av[0]);
   }
   exit (ret);
}
//===============================================================
// DOW - Return the day of the week value 0-6 (0 = Sunday)
//       based on the date (month, day, year) and calendar
//===============================================================
long dow (month, day, year, calendar)
int              month, day, year, calendar;
{
   static char month_val[12] = {
     // J F M A M J J A S O N D
        6,2,2,5,0,3,5,1,4,6,2,4
   };

 return ((  day                                        \
          + (month_val [month - 1])                    \
          - ((month < 3)                               \
             ? ((calendar == GRG)                      \
               ? (((!(year % 4)) &&                    \
                   ((year % 100) || (!(year % 400))))) \
               : (1*(!(year % 4))))                    \
             : 0                                       \
            )                                          \
          + year                                       \
          + (year / 4)                                 \
          + ((calendar == GRG)                         \
             ? ((year / 400) - (year / 100))           \
             : 5                                       \
            )                                          \
         ) % 7                                         \
        );
}

//===============================================================
//  HELP - Print the help info
//===============================================================
static void help (fn)
char             *fn;
{
 printf ("\nWelcome to DOWGJ (DOW Gregorian or Julian) Version 1.1\n");
 printf ("                                        by R. Viscogliosi\n");
 printf ("\nTo use it, please enter:\n");
 printf ("\n  %s  mm dd yyyy [c]\n", fn);
 printf ("\n  (If [c] is specified then the date is in Julian,\n");
 printf ("   else the date defaults to the Gregorian calendar)\n");
 printf ("\n  (e.g. 'DOWGJ  10 12 1492 j' was on Friday (Julian))\n");
}
```

Figure 3: **The C source code listing for a program that determines the day of the week for any date, from the year 0 on.**

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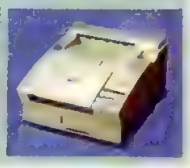

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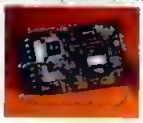

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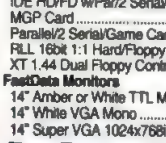

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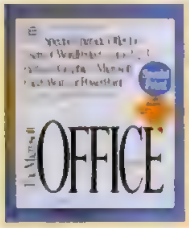

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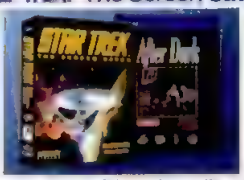

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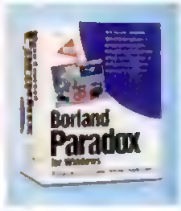

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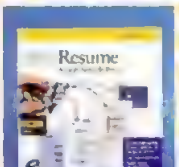

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DOWGJ2.C

Complete Listing

```
/*****************************************************************
   DOWGJ2 -  Day_Of_the_Week Gregorian or Julian calendar
*****************************************************************

  Author: Roberto R. Viscogliosi
  Date Written : 10/92
  Release: 1.1a

  Modified by Douglas Boling

  Program's Purpose:
      This program computes the Day_Of_the_Week for a given date
      using the Gregorian calendar as default, or the Julian calendar
      when an extra argument is given at the command line.

  Input Arguments:
      mm dd yyyy [c]
      where:
        mm   = month
        dd   = day
        yyyy = year
        [c]  = any value forces the use of the Julian calendar;
               no value uses the Gregorian calendar.

  Example:
      The input, "DOWGJ2  10 12 1492 j" shows that Columbus discovered
      the New World on a Friday (Julian calendar).

  Returns:
      0    OK
      1    Invalid calling syntax/Invalid Input Data

   Last change:  14 Jan 93       2:34 pm
*****************************************************************/

#include <stdlib.h>
#include <stdio.h>

#define  OK   0
#define  GRG  1

long dow (int, int, int, int);
void help (char *);

//=================================================================
// MAIN process
//=================================================================
int main (ac, av)
int ac;
char *av[];
{
   int day, month, year, calendar = GRG, ret = OK;

   static char *dowstr[7] = {
      "Sunday", "Monday", "Tuesday", "Wednesday",
      "Thursday", "Friday", "Saturday"
   };

   for (;;) {
      // check arguments passed
      if  (ac < 4) {          // not enough args.
          ret = !OK;
          break;
      }
      // get/verify the input values
      if  (((month = atoi (av[1])) < 1) ||
           ((day   = atoi (av[2])) < 1) ||
           ((year  = atoi (av[3])) < 1)
          ) {                 // invalid values
          ret = !OK;
          break;
      }
      // check if Julian calendar requested
      if  (ac > 4) {          // reset the calendar indicator
          calendar = !GRG;
      }
      // prevent overflow by check year size
      if  (year > 9999) {     // year too large
          ret = !OK;
          break;
      }
      // compute and show the day_of_the_week
      printf ("%02d/%02d/%04d is on %s %s\n",
              month, day, year,
              dowstr [dow (month, day, year, calendar)],
              (calendar == GRG) ? "" : "(Julian calendar)"
            );
      break;
   }
   // check for errors
   if  (ret) {
      help (av[0]);
   }
   exit (ret);
}

//=================================================================
// DOW - Return the day of the week value 0-6 (0 = Sunday)
//       based on the date (month, day, year) and calendar
//=================================================================
long dow (month, day, year, calendar)
int       month, day, year, calendar;
{
   static char month_val[12] = {
     // J F M A M J J A S O N D
        6,2,2,5,0,3,5,1,4,6,2,4
   };
   long DayOfWeek;

   DayOfWeek = day + month_val[month - 1];

   if (month < 3) {
      if (calendar == GRG) {
      if (!(year % 4) && (year % 100) || !(year % 400))
            DayOfWeek--;
      } else
    if (!year %4)
        DayOfWeek--;
   }

   DayOfWeek += year + (year / 4);
   if (calendar == GRG)
      DayOfWeek += (year / 400) - (year / 100);
   else
      DayOfWeek += 5;

   DayOfWeek %= 7;
   return DayOfWeek;
}

//=================================================================
// HELP - Print the help info
//=================================================================
void help (fn)
char      *fn;
{
 printf ("\nWelcome to DOWGJ2 (DOW Gregorian or Julian) Version 1.1\n");
 printf ("                                          by R. Viscogliosi\n");
 printf ("                                 modified by Douglas Boling\n");
 printf ("\nTo use it, please enter:\n");
 printf ("\n  %s  mm dd yyyy [c]\n", fn);
 printf ("\n  (If [c] is specified then the date is in Julian.\n");
 printf ("   else the date defaults to the Gregorian calendar)\n");
 printf ("\n  (e.g. 'DOWGJ2  10 12 1492 j' was on Friday (Julian))\n");
}
```

Figure 4: **A modified version of the source code in Figure 3. This version uses "if" statements and explicitly incremented variables, instead of directly modifying variables with conditional operators in a one-line function as the first listing does.**

DOWGJ2.C, shown in Figure 4, the conditional statements have been replaced by `if` statements, and variables are explicitly incremented or decremented as necessary depending on whether a condition is true or false, instead of having the result of the conditional expression added directly to variables.

Mr. Viscogliosi's routine shows the lengths to which a clever programmer can go in order to condense a routine into the smallest possible number of lines. The problem with this approach is that you tend to sacrifice readability. It used to be believed that compressing functions into one line would lead to a smaller executable, but with today's excellent compilers, this is not always the case. In one round of compiling the two versions of this program, DOWGJ2 actually yielded a smaller .EXE. The C conditional operator is a powerful tool, but its overuse can lead to confusing code.

—*Douglas Boling* □

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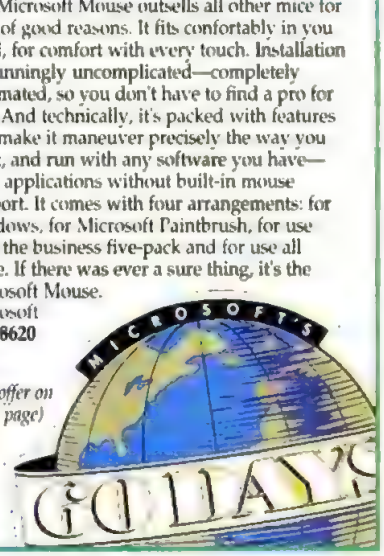
The Microsoft Mouse outsells all other mice for a lot of good reasons. It fits comfortably in you hand, for comfort with every touch. Installation is stunningly uncomplicated—completely automated, so you don't have to find a pro for help. And technically, it's packed with features that make it maneuver precisely the way you want, and run with any software you have—even applications without built-in mouse support. It comes with four arrangements: for Windows, for Microsoft Paintbrush, for use with the business five-pack and for use all alone. If there was ever a sure thing, it's the Microsoft Mouse.
Microsoft
D #08620

(See offer on right page)



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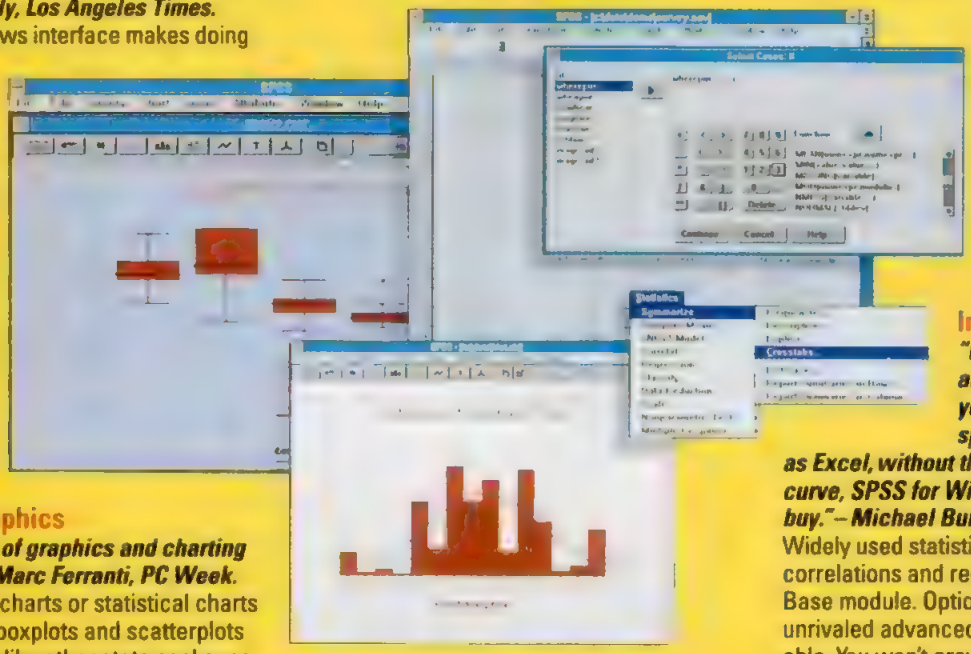

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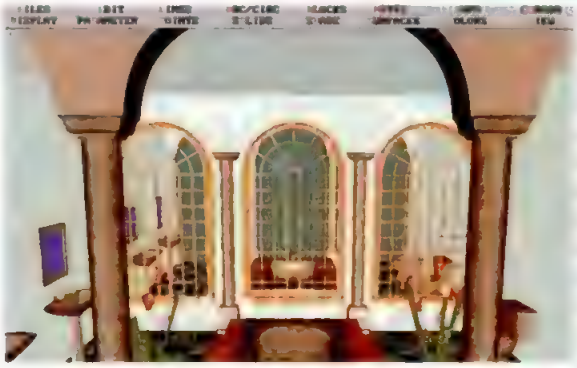

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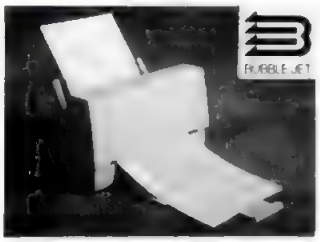

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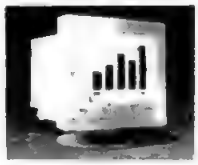

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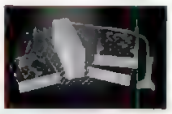

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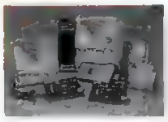

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	8Meg Kit	500967-003	318 00
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Premium 386/33	1Meg	500718-002	56 00
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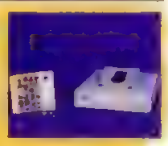

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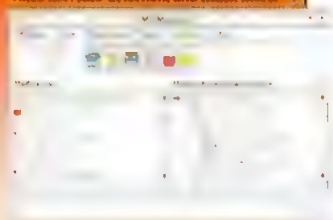

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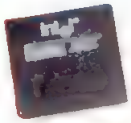

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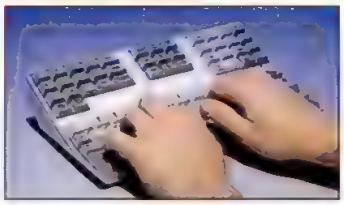

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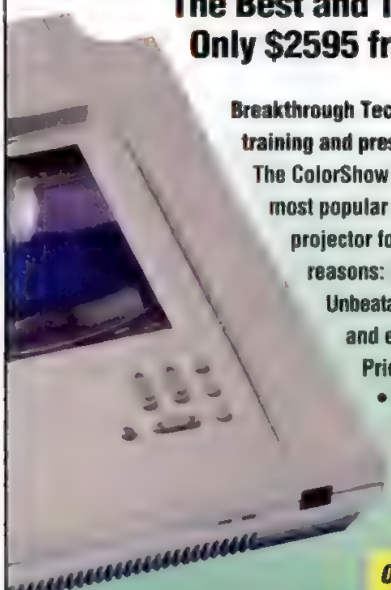

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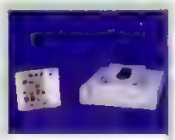

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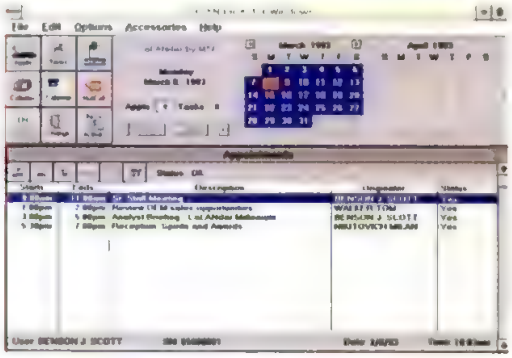

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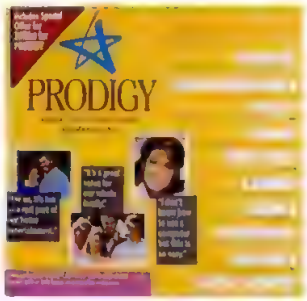

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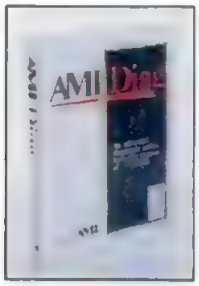

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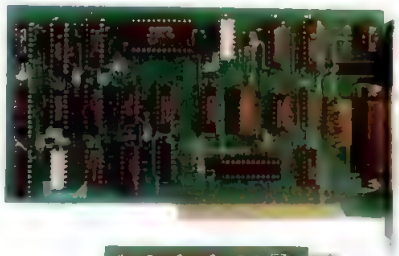

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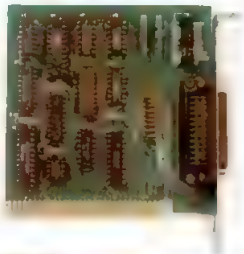

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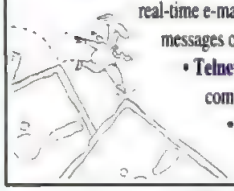

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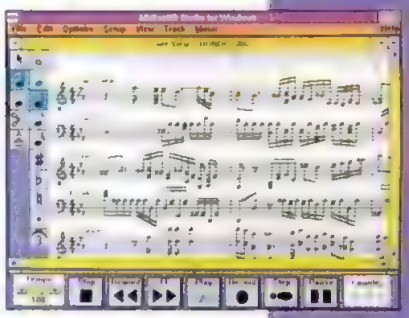

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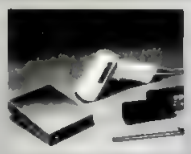

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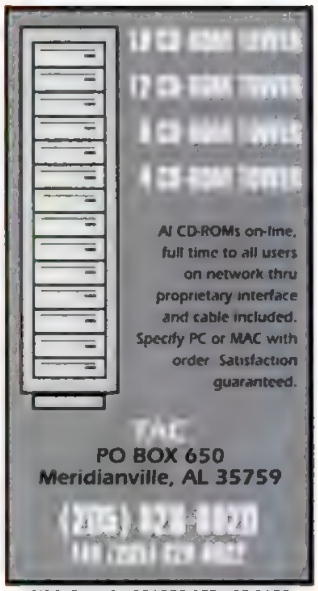

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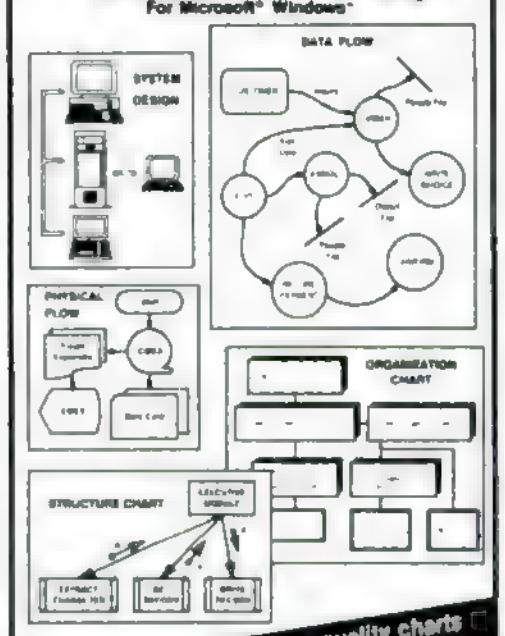

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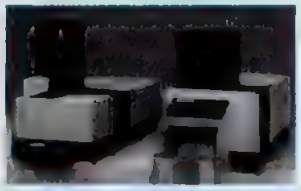

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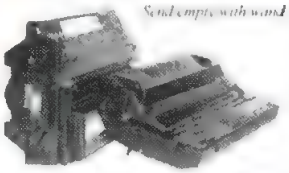

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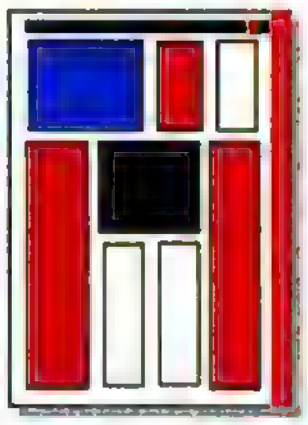

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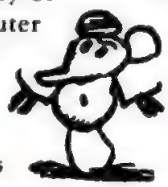

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PC MAGAZINE

Coming Up

The Politically Correct PC

Is your PC hazardous to your health and to the environment? What are the new technologies and designs that address the many problems in today's offices? What can you do to reduce waste and pollution? *PC Magazine* tests monitors and power supplies, looks at peripherals and office furniture, and examines ways to reduce the impact of today's industries to answer these questions and determine what makes the perfect ergonomic office.

GUI Peer-To-Peer LANs

Need to connect two PCs? Want to share your printer with your coworkers? How about hooking together an office with Windows, DOS and Macintosh computers, NetWare servers, printers, and CD-ROM drives? Peer-to-peer LANs aren't just for small offices anymore. We review packages from Artisoft, Invisible Software, Microsoft Corp., NET-Source, Novell, Tiara Computer Systems, and WEBCorp.

Writers' Tools

Standalone writers' tools—dictionaries, thesauruses, and grammar/style checkers—help to ensure the accuracy and readability of the things we write. They give us the right spelling when we need it, a better word—if we want it, and the right quote to illustrate a point. In our next issue, *PC Magazine* will help writers to pick out the *write* tools by looking at the latest crop of all-in-one toolkits, thesauruses, style guides, and quotation dictionaries.

Digitizing Tablets

CAD users know the potential frustrations of navigating through dozens of functions to pick the exact shape or tool they need, especially when program menus aren't artfully arranged. Digitizing tablets can help smooth out these rough edges. In this review, *PC Magazine* looks at 11 digitizing tablets in the most popular sizes for CAD applications: 12 by 12 and 12 by 18 inches.

Tutor

Data compression comes in many forms. To help you understand how this technology works, Jeff Prosise looks at a simple lossless compression algorithm known as run-length encoding, and briefly discusses the compression algorithms used by PKZIP (ever wonder what PKZIP is really doing when it says "shrinking" or "imploding?") and DOS 6's DoubleSpace. □

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After Hours

Staying Well: Mayo Clinic Family Health Book; The Family Doctor; Wellness Checkpoint; Dr. Schueler's Home Medical Advisor; Vital Signs: The Good Health Resource; Staying Healthy in the '90s: What Everyone Should Know About AIDS

STAYING WELL

Five Home Medical Packages Keep You Healthy and Informed

BY DONALD B. TRIVETTE

You can get healthy or you can stay well. That's the idea behind the health reference products that are now available for the PC.

The Mayo Clinic Family Health Book, The Family Doctor, Wellness Checkpoint, Dr. Schueler's Home Medical Advisor, and Vital Signs: The Good Health Resource all concentrate on organizing medical and health materials and making them more accessible for home users. Dr. Schueler's Home Medical Advisor tries to diagnose your ailments.

Four of the five products are worth considering: the Mayo Clinic Family Health Book features beautiful illustrations and an intuitive interface, but it takes a powerful multimedia system to do this CD-ROM package justice. The Family Doctor's question-and-answer format and comforting tone will appeal to some users.

For those users who don't have a CD-ROM drive, Dr. Schueler's Home Medical Advisor is an excellent choice. Wellness Checkpoint has some value as a self-improvement package. The Vital Signs program, plain and artless, ranks a distant fifth.

SONY ELECTRONIC PUBLISHING

Mayo Clinic Family Health Book

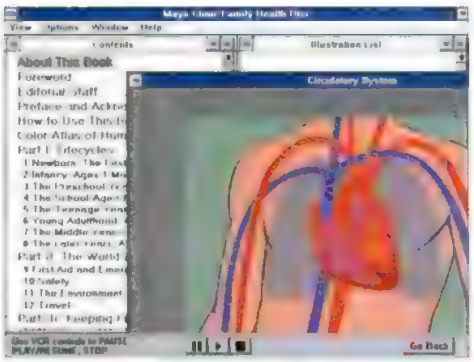
The Mayo Clinic, surely the most famous health-care facility in the world, attracts kings and queens and moguls and movie stars to its three facilities. Now you can tap into some of the Mayo expertise without leaving your home. The Mayo Clinic Family Health Book, distributed by Sony Electronic Publishing, breathes new life into the best-selling, 1,300-page hard-copy book of the same title. The software continues where the book ends, adding sound and superb animation to a solid reference document.

The Mayo Clinic Family Health Book contains five sections: Lifecycles, the World Around Us, Keeping Fit, Human Disease and Disorders, and Modern Medical Care. Two full-color photographic sections, Guide to Common Skin Disorders and Atlas of the Body, supplement the written text. The former is a useful reference for identifying rashes, sores, bumps, and fungus infections. The atlas, while attractive, lacks some detail and doesn't include many secondary organs.

A pull-down menu lets you browse through the data or search for a specific topic, and you can use wildcard notation to find subjects when you are unsure of their spellings. The pull-down menu also contains a list of the book's 45 animated illustrations. These animations, which show such topics as blood circulation, a barium X-ray of the stomach, the menstrual cycle, and valvuloplasty can be viewed in sequence or brought up from appropriate places within the text, as can approximately 500 static illustrations.

IMPRESSIVE ILLUSTRATION

The illustration that accompanies the program's Color Atlas of Human Anatomy will surely impress you. When you drag your cursor across a slider bar, this illustration appears to metamorphose, beginning as the torso of an adult woman and ending as the aged woman's skeletal structure.



Animation and sound take the Mayo Clinic Family Health Book CD-ROM a step beyond the book.

Mayo Clinic uses the multimedia interface to tremendous advantage. Browsing and searching are intuitive, and the program uses hypertext (displayed in green) to simplify finding related material.

In addition, 90 minutes of audio accompanies the graphics. Squeezing it on the disk required using discrete left and right audio channels. If your CD-ROM player can't automatically switch between the two, as some older players can't, sound will be garbled.

THE NEED FOR SPEED

The price to pay for this great technology is speed. On a 386SX running Windows, the slowest computer recommended, you're likely to wait several seconds while material is fetched from the disk. Animation in some places is often slow and jerky on this type of system. On a 486 with a fast CD-ROM drive, however, the Mayo Clinic Family Health Book becomes a very attractive medical reference.

The developer plans to issue an updated electronic version of Mayo Clinic in spring of 1994 to coincide with release of the second edition of the printed book.

Mayo Clinic Family Health Book, *$69.95.* Requires: *4MB RAM, 3MB hard disk space, Microsoft Windows 3.0 or later, CD-ROM and extensions. Sony Electronic Publishing, 1 Lower Ragsdale Dr., Monterey, CA 93940; 408-372-2812; fax, 408-372-9267.*

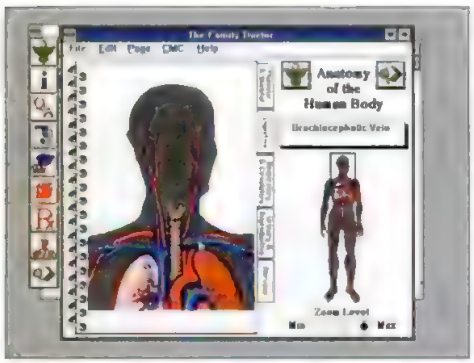
Circle 456 on reader service card

CREATIVE MULTIMEDIA CORP.

The Family Doctor

Dr. Allan Bruckheim's column, The Family Doctor, appears in some 200 newspapers across the country. Creative Multimedia Corp. has compiled those columns, with their straightforward answers to readers' questions, and placed them on one CD-ROM called, appropriately enough, The Family Doctor. Your enjoyment of this program will depend on how well you respond to Dr. Bruckheim's writing style and his advice.

The Family Doctor is divided into seven sections: Introduction, Questions & Answers, Illustrations, Resources & Support Groups, Health Booklet Update, Consumer Guide to Prescription Drugs, and Anatomy of the Human Body. Each section can be selected by clicking either the title or an icon on the floating menu bar.



The Family Doctor: Physician and columnist Dr. Allan Bruckheim answers hundreds of medical questions.

More than 300 illustrations can be found under such headings as Bodily Processes, Diseases and Injuries, and Medical Procedures, though these illustrations may remind you of the posters you find in your own doctor's office. You can bring up full-color drawings for everything from a noncemented hip replacement to a six-step, self-administered breast examination.

The question-and-answer section covers 2,000 topics, a few of which are sure to be of interest to even the most stoic user. Here you'll find answers ranging from serious conditions such as heart disease, AIDS, cancer, and broken bones to information on more arcane topics like leprechauns, curved toenails, and chewing-gum diarrhea.

DOS AND WINDOWS IN ONE

When you purchase the CD-ROM, you'll get both the DOS and Windows versions of The Family Doctor. There's even a Mac version on the same disk. The Windows interface makes the program a snap to use. The DOS version's anatomy section is less powerful and has no audio. But sound plays a limited role in this product anyway: Click the right mouse button on an anatomical part and an audio-equipped computer will pronounce it.

The Family Doctor lacks hyperlinks in the usual sense; you can't, for example, click on a word embedded in the text to retrieve additional information. But you can use both an Additional Materials box and a rather good keyword search to find related articles and illustrations.

To navigate through the data, you'll have to catch on to some of The Family Doctor's unusual techniques. For instance, the Additional Materials box defied my exploration until I learned to click and hold with the right mouse button.

In addition, The Family Doctor lacks two useful features: a comprehensive alphabetical index and a way to perform wildcard searches. Unless you're a crackerjack speller, you may find it difficult to find medical terms without being able to enter something such as OST*, for osteoporosis.

The Family Doctor, *$79.99.* Requires: *2MB RAM, Microsoft Windows 3.0 or later, CD-ROM and extensions. Creative Multimedia Corp., 514 NW 11th Ave., Portland, OR 97209; 503-241-4351; fax, 503-241-4370.*

Circle 457 on reader service card

HEALTHSOFT

Wellness Checkpoint

Who wouldn't jump at the chance to find out how healthy we are? Wellness Checkpoint from HealthSoft forecasts your health through a series of yes-or-no and multiple-choice questions.

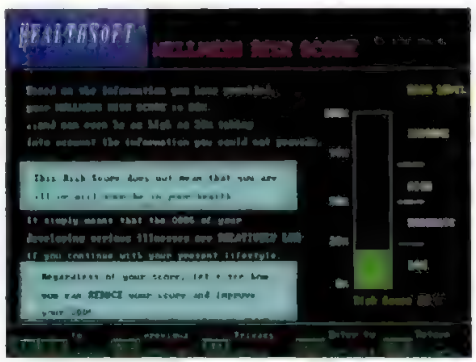
To get this prediction, you'll have to answer a detailed survey about your health history, habits, environment, and family diseases in order to evaluate your physical well-being. Compiled by a group of Canadian physicians, the questionnaire focuses on habits—generally things we can do something about. Questions include: Do you eat beans or lentils often? How many years since you quit smoking? Do you exercise vigorously every day? Do you lay out in the sun on weekends? Do you always wear a seat belt? The program neglects to ask about illegal drug use and sexual activity, although these could be important factors.

Even as you answer the questions, you'll begin to see where you can improve your chances by making some simple lifestyle changes.

Some of the questions are gender specific; out of about 160 total, men can expect to answer about 120, while women will be asked a few more, mostly regarding the reproductive system. The entire survey takes about 15 minutes.

YOUR RISK SCORE

After you've completed the survey, Wellness Checkpoint displays a vertical bar chart that shows your wellness risk score. That score comprises two factors: family risk and lifestyle risk. My own score was just 22 percent—low on the scale of Low-Moderate-High-Extreme. But what does this really mean? The program hedges, and a spokesman for HealthSoft was equally vague. All I know is that a 100 is bad but not terminal, and a 0 score is very good but impossible to attain.



Answer Wellness Checkpoint's questionnaire and learn how changing your lifestyle can improve your health.

Wellness Checkpoint provides powerful incentive for altering your habits. Set goals—eat more broccoli, drink less alcohol, always wear seat belts—and you get imme-

diate feedback on how this decreases your risk. The goals can be recorded and printed.

There are several things I like about Wellness Checkpoint and a few that I don't. On the positive side, it is easy to go back if you misunderstand a question. The program also lets each member of the family save and recall his or her own survey. On the negative side, the interface is labored. For example, after you start the program you have to press Enter twice after you type your name and twice more after your password. Navigation depends on cursor keys, even though it's a natural application for a mouse. In some places the text automatically advances every few seconds, instead of waiting for you to press Enter.

The second part of the program, the Wellness Game, is best described as lame. A series of flash cards gives a few facts about smoking, eating, relaxing, and exercising. The information presented is basic, and the presentation is boring. It reminds me of the overhead projection in a high school health class. Wellness Checkpoint gets raves for its health survey and boos for its tutorial.

Wellness Checkpoint, *$99.* Requires: *640K RAM, DOS 3.1 or later, 1MB hard disk space. HealthSoft, 1100 Moraga Way, Moraga, CA 94556; 800-795-4325; fax, 510-631-6735.*

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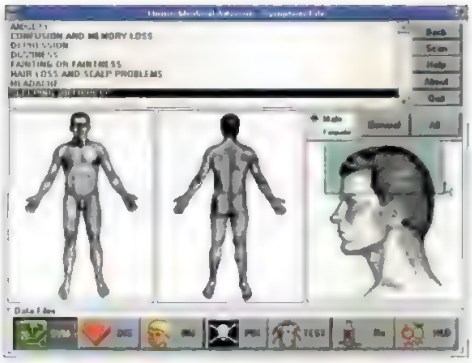
PIXEL PERFECT INC.

Dr. Schueler's Home Medical Advisor

Dr. Schueler's Home Medical Advisor is a hypochondriac's



A Hypochondriac's dream: Home Medical Advisor helps users diagnose their ailments at home.

dream. With its pointed questions and a vast database, this program helps diagnose hundreds of diseases.

Distributed by Pixel Perfect, Home Medical Adviser covers about 3,000 topics, including the treatment of nearly 500 diseases, 1,200 prescription drugs, 500 household poisons, and a description of 130 common medical tests. To get to this information, click on one of seven icons at the bottom of the main menu: Symptoms, Diseases, Injuries, Poisons, Tests, Drugs, or Health and Diet.

WHY ARE YOU SO DIZZY?

Home Medical Advisor's Symptoms section shines. You highlight an area on an anatomical chart and the software presents a list of possible symptoms. Highlight the head, for example, and you'll find possibilities such as Dizziness, Headache, and Depression. Click on Dizziness and you'll get a specific list of possible causes.

If none of those causes seem likely, click the Next button and the software asks you a series of yes-or-no questions. If you answer yes to "Any confusion, weakness, or difficulty speaking?" Home Medical Advisor asks you if that symptom is still occurring. Eventually the program will suggest a particular illness—in this case, a stroke or a transient ischemic attack. If you answer no to all questions, the program gives up and suggests you try a different symptom or see a physician for diagnosis.

If you don't need a diagnosis, you can go directly to a topic by using the scan button to enter a keyword, words, or part of a word; this searches all seven sections. Although this isn't a true wildcard search, it's good enough to find topics you have only a vague idea how to spell. Enter colo, for example, and you'll get topics relating to the colon and also a hit on watercolors in the poison file.

Home Medical Advisor uses a simplified Windows interface that doesn't allow resizing or multiple windows. Though the program is both easy to use and attractive, the text is a little more terse than that in Mayo Clinic and The Family Doctor, and I missed the descriptive and tutorial pictures. Home Medical Advisor uses drawings only in the Symptoms section and then only to help you focus on a particular area ("Does it hurt here?").

Though Dr. Schueler him-

Staying Healthy in the '90s: *AIDS Info for Everyone*

PROMOTING AIDS AWARENESS: *Originally developed as a guide for hospital and health care professionals, Staying Healthy in the '90s: What Everyone Should Know About AIDS ($89.95) addresses HIV infection and AIDS in a factual but lively and interactive style. Users learn how the virus is and isn't contracted, how it's replicated, how to care for HIV-positive people, and how to avoid HIV in the first place (with heavy emphasis on safer sex, including abstinence). Through high-res animated sequences and periodic quizzes, the program captures the user's attention; Staying Healthy's clear, detailed explanations of right and wrong answers reinforce the facts about a disease that has killed more than 400,000 Americans to date. (Io International Consulting, 800-367-8288.)*

Home Medical Advisor

self is a real physician, the program includes a strong caveat and disclaimer: The program is not a substitute for physician evaluation and treatment. As a tool for becoming a more knowledgeable patient, however, it's a good start.

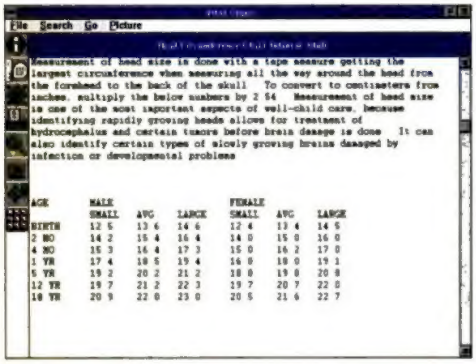
Doctor Schueler's Home Medical Advisor, *$99.95.* Requires: *4MB RAM, 3.2MB hard disk space, Microsoft Windows 3.1. Pixel Perfect Inc., 10460 S. Tropical Trail, Merritt Island, FL 32952. 800-788-2099; fax, 407-777-0323.*

Circle 459 on reader service card

TEXAS CAVIAR INC.

Vital Signs: The Good Health Resource

If Texas Caviar's Vital Signs were the only program in its field, it might be worth a look. But with the other choices in medical reference software, this one is hard to recommend.



Vital Signs is little more than a compilation of data from federal government publications.

Vital Signs falls shortest in its organization. Information is grouped not by medical category, but by the headings Babies, Children, Teenagers, Women, Men, Aging, Emergency Resources, Telephone Resources, and Activities. As a result, the program often repeats itself. Lyme disease, for example, appears as a topic under children, teenagers, women, and men.

The interface also lacks many of the features we associate with Windows; you can't, for example, minimize a window or open two windows at once. In many cases, when you position the slide bar at the bottom of its range, the entire screen blanks. There's a search feature, although it lacks a wildcard notation. A search will, however, let you pull up an alphabetical index of key words, so you aren't lost if you don't know how to spell something.

GOVERNMENT INFORMATION

Much of the information in Vital Signs comes from state and federal government publications and medical organizations such as the American Diabetes Association. Though accurate, the material is presented in so dry and unoriginal a manner, it's like reading government pamphlets. There are no colorful charts or animations. On a more positive note, the developer plans to update the medical data yearly.

The letters MPC on the box suggest Vital Signs is a multimedia product, but the use of sound and graphics in this product is as underwhelming as the rest of the package. Your best bet is to consider one of the other packages in this roundup. □

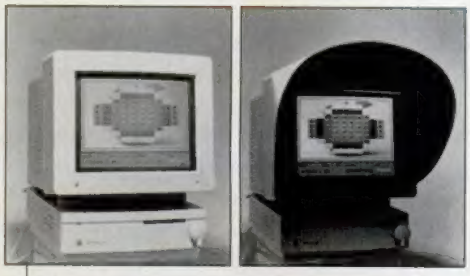
Vital Signs, *$95.* Requires: *2MB RAM, 1MB hard disk space, Microsoft Windows 3.0 or later, CD-ROM drive and extensions. Texas Caviar, 3933 Spicewood Springs Rd., Suite E-100, Austin, TX 78759; 512-346-7887; fax, 512-346-1393.*

Circle 460 on reader service card

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

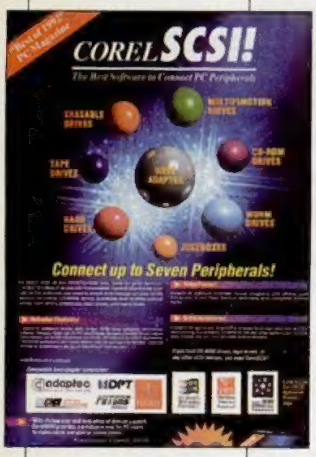
By Robin Raskin



TUNNEL VISION? The Darkfield Image Enhancer (Advanced Environmental Systems).

Misplaced Priorities?

"A female software programmer is outselling Madonna on the Eastside (Seattle). At Tower Books in Bellvue, Helen Custer's *Inside Windows NT* (Microsoft Press) has, as of last week, outsold Madonna's *Sex* by 125 to 109."
—*The Seattle Times*, Jan. 21, 1993



Corel's Misplaced Marketing?

Talk about strangely targeted marketing! We're still trying to figure out why the January 14, 1993, issue of *USA Today* featured a full-page ad for CorelSCSI. (Cost of the ad: $149,151.)

ARF Interactive

We asked: What does the "NT" in Windows NT really stand for?

NetWare Takeover
Norton's Troubles
Never-ending Trek
Next Terror
Nefarious Titillation
Nice Toy

So Is It Software or Deodorant Soap?

Springtime Software, vendor of Windows utilities called WindList, BitView, and BtnAid, says in a press release that its programs "make it as easy and fun to program as the freshness we feel at Springtime."

GROANERS

Have you heard about "stealth education"? It's the result of edutainment. . . .

"You know what they say about paradigms," said Allain Rossman, president of EO to a group at this year's PC Forum. "Shift happens."

Potable

- SVGA 1024x768x.26 Color Monitor with Sony Trinitron Tube
- 3 Drive Bay
- 200 Power Supply
- Custom Build EISA, VESA,ISA 386, 486, 486DX2 CPU
- 6 expansion slots

Is this is the first drinkable computer?

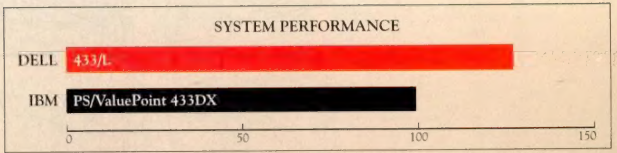
Richard Tennant

10 YEARS AGO IN *PC MAGAZINE*

"Crowing about the PC's much-vaunted graphics ability and then showing it off with a boring bouncing ball and a pathetic screen of random boxes self-mockingly called 'The City' is a joke. Virtually everything about the PC is of first-water quality, but these uninspired demos are pure zircon."
—Paul Somerson on the sample BASIC demos included with DOS 2.0

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Winners this issue: Craig Johnson (Madonna madness); Richard Lim, Donald Dunn, and Richard L. Mendes (NT Interactive); Mayra Almonte (PCs and H_2O); Lori Grunin (stealth education).

NOT SO FAST, IBM.



Test results obtained by Dell Performance Measurement Lab by running BAPCo SYSmark92. Dell 433/L and IBM PS/ValuePoint 433DX both configured with 4MB RAM, 120MB HD, 1MB VRAM, 128KB cache.

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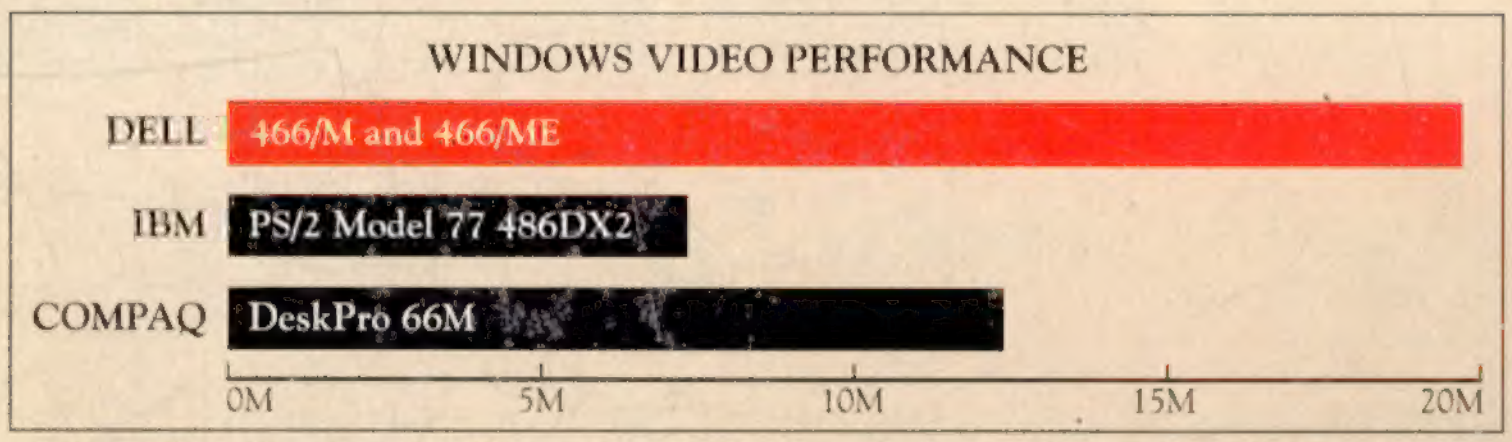
COMPAQ'S AND IBM'S VIDEO IS BEHIND THE TIMES.



Performance measured by running WINBENCH version 3.1 at 640 x 480, 256 colors. Results measured in millions of WINMARKS. Results for IBM and Compaq as published by PC Magazine in issue dated January 26, 1993. Results for Dell 466/M and 466/ME provided by Dell Performance Measurement Lab, January 1993. DeskPro 66M configured with 8MB RAM, 210MB IDE HD, QVision 1024/E controller with 1MB VRAM. PS/2 model 77 486DX2 configured with 8MB RAM, 400MB SCSI HD, XGA-2 with 1MB VRAM and 256KB cache. 466/M and 466/ME both configured with 8MB RAM, 170MB IDE HD, local bus video with 1MB VRAM, and 128KB cache.

Our Dell 466/M and 466/ME with over 19 million WinMarks, out ran the Compaq DeskPro 66M with QVision and IBM PS/2 Model 77 486 DX2 with XGA-2.* That means we're up to 57% faster than QVision and up to 174% faster than XGA-2. Thanks, of course, to our accelerated local bus video and fast drivers for Windows applications. Both help put the Dell® 466/M a little ahead of its time.

intel inside

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